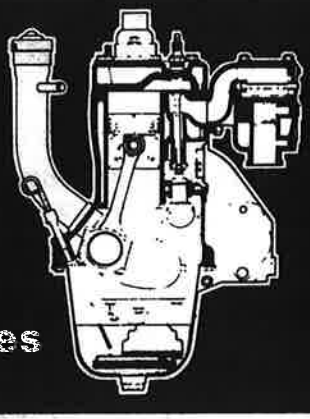
OPERATORS MAINTENANCE & OVERHAUL MANUAL

Continental L-Head Engines

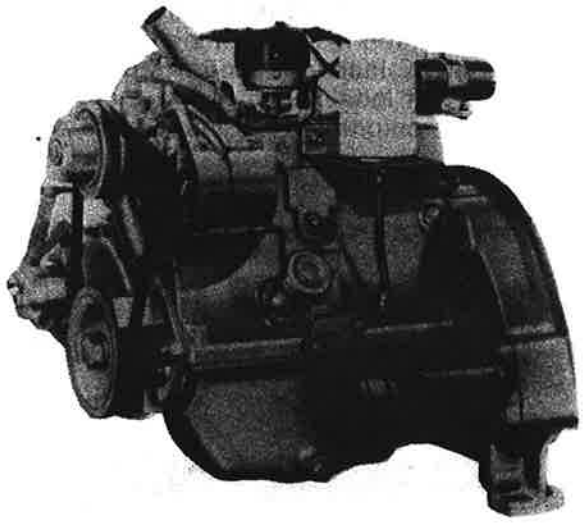
TELEDYNE TOTAL POWER

L-head engines



Operators Maintenance & Overhaul Manual

TC56



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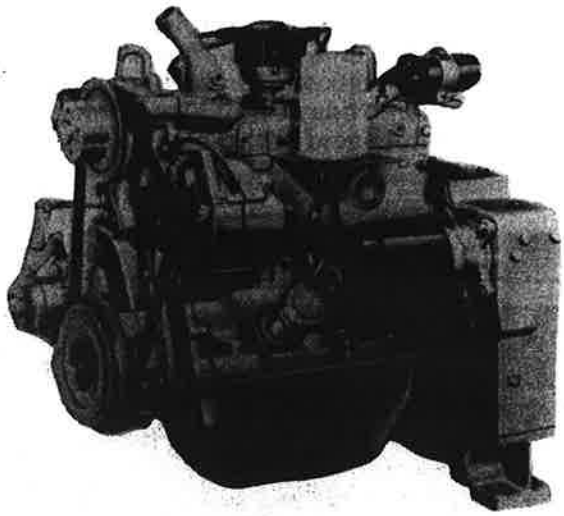

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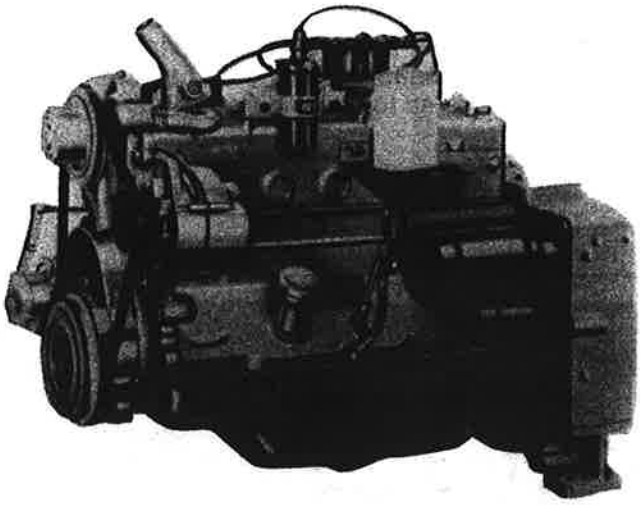


F227/F245

IMPORTANT SAFETY NOTICE

Proper repair is important to the safe and reliable operation of an engine. This Service Manual outlines basic recommended procedures, some of which require special tools, devices or work methods.

Improper repair procedures can be dangerous and could result in injury or death.

READ AND UNDERSTAND ALL SAFETY PRECAUTIONS AND WARNINGS BEFORE PERFORMING REPAIRS ON THIS ENGINE

Warning labels have also been put on the engines to provide instructions and identify specific hazards which if not heeded could cause bodily injury or death to you or other persons. These labels identify hazards which may not be apparent to a trained mechanic. There are many potential hazards for an untrained mechanic and there is no way to label the engine against all such hazards. These warnings in the Service Manual and on the engine are identified by this symbol:

Operations that may result only in engine damage are identified in the Service Manual by the word **CAUTION.**

Continental cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this manual are therefore not all inclusive. If a procedure, tool, device or work method not specifically recommended by Continental is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the engine will not be damaged or made unsafe by the procedures you choose.

IMPORTANT The information, specifications and illustrations in this book are on the basis of information available at the time it was written. The specifications, torques, pressures of operation, measurements, adjustments, illustrations and other items can change at any time. These changes can affect the service given to the product. Get the complete and most current information before you start any job. Continental Warehouse Distributors/Dealers have the most current information which is available. For a list of current Warehouse Distributors/Dealers, refer to directory X-30171.

⚠ WARNING

Most sub-systems used in conjunction with Continental industrial engines including, but not limited to, radiators, hoses, fans, fuel tanks, fuel lines or other fuel system components, batteries, electrical connections or other electrical components, clutches, transmissions, hydraulic pumps and generators, are not supplied by Continental, but are provided by the manufacturer of the end item in which the engine is used.

Some of the dangers associated with servicing such items are generally mentioned in this manual; however, the appropriate handbooks and safety instructions provided by the manufacturer of the end item should always be consulted prior to undertaking any work on sub-systems attached to the engine, to avoid any hazards inherent to these sub-systems.

⚠ WARNING

Read and observe all individual safety warnings as you use this manual to operate, service or repair your engine.

Always exercise caution whenever working with an engine or any associated system.

Injuries may be caused by lack of care when working with, or near, moving parts, hot parts, pressurized systems, electrical equipment, or fuel systems.

Always wear eye and hearing protection when working on or near engines.

Improper attire such as loose clothing, ties, rings, soft shoes or bare feet could be hazardous and should be avoided when servicing engines.

Use or service of the engine (including the use of modified parts or materials) not in accordance with manufacturer's specifications could damage your engine or cause personal injury.

⚠ WARNING

Some equipment and materials used in the overhaul or maintenance of an engine such as machine tools, electrical equipment, compressed air, solvents, gasoline or other fuels may be dangerous and can cause injury. Always observe safety precautions associated with these items.

⚠ WARNING

Read and observe all individual safety warnings as you use this manual to operate, service or repair your engine. See pages 1 and 2.

FORWARD

Good operation and a **planned** maintenance program as outlined in this manual are of vital importance in obtaining maximum engine performance, and long engine life. The instructions on the following pages have been written with this in mind, to give the operator a better understanding of the various problems which may arise, and the manner in which these problems can best be solved or avoided.

Procedures in the Preventive Maintenance Section must be set up and followed by the owner and operator to obtain dependable service and long life from the engine. Owners and operators are expected to perform these maintenance procedures as outlined under the daily schedule as well as 50-hr., 250 hr., and 500 hr. periods WHILE IN THE WARRANTY PERIOD AS WELL AS DURING THE LIFE OF THE ENGINE.

Warranty service does not include tune-up of the engine such as replacing spark plugs, distributor points, tappet settings, ignition timing. ignition wiring, air cleaner service and lubrication and filter maintenance.

The operator is cautioned against the use of any parts, other than **Genuine Continental Parts** for replacement or repair. These parts have been engineered and tested for their particular job, and the use of any other parts may result in unsatisfactory performance and short engine life. Likewise, Continental distributors and dealers, because of their close factory relations, can render the best and most efficient service.

THE LIFE OF YOUR ENGINE DEPENDS ON THE CARE IT RECEIVES.

Contents

INDUSTRIAL L-HEAD ENGINES

Industrial L-head Engines

MODEL	TC 56	Y112	F163	F227	F245
No. of Cylinders	2	4	4	6	6
Bore & Stroke	3-3/16 x 3-1/2	3-3/16 x 3 1/2	3-7/16 x 4-3/8	3-5/16 x 4-3/8	3-7/16 x 4-3/8
Displacement Cu. In.	56	112	162	226	244
Compression Ratio	8:1	8:1	7.4:1	7.52:1	7.5:1
Max. Oil Pressure	30-40	30-40	30-40	30-40	30-40
Min. Oil Pressure (Idling)	7	7	7	7	7
Firing Order	1-2	1-3-4-2	1-3-4-2	1-5-3-6-2-4	1-5-3-6-2-4
Main Brg. Frt.	1-3/4 x 1-7/32	1-3/4 x 1-7/32	2-3/8 x 1-1/16	2-3/8 x 1-1/16	2-3/8 x 1-1/16
Main Brg. Int.				(2) 2-3/8 x 1-5/16	(2) 2-3/8 x 1-5/16
Main Brg. Center	1-3/4 x 1-7/16	1-3/4 x 1-7/16	2-3/8 x 1-23/64		
Main Brg. Rear	1-3/4 x 1-7/16	1-3/4 x 1-7/16	2-3/8 x 1-5/8	2-3/8 x 1-23/64	2-3/8 x 1-23/64
Conn. Rod Brg. Dia. & Length	1-1/2 x 1	1-1/2 x 1	2-1/16 x 1-1/8	2-1/16 x 1-1/8	2-1/16 x 1-1/8
Oil Capacity (Quarts)					
Crankcase	2	3-1/2	4	5	5
Filter	1/2	1/2	1/2	1/2	1/2
Total	2-1/2	4	4-1/2	5-1/2	5-1/2
Valve Clearance					
Intake	.012	.012	.012	.012	.012
Exhaust	.020	.020	.020	.020	.020
Water Capacity (Quarts)					
Engine	21/2	3-3/4	5	6-1/2	6-1/2
Weight (Bare Engine) (lbs.)	220	290	415	555	565

INFORMATION FOR ORDERING PARTS

When ordering parts, refer to the **engine name plate** attached to side of the cylinder block, which lists the **model** and **serial number.** In most cases a **specification** number is listed. This data is of vital importance in obtaining the correct parts: **always include this information on your parts order.**

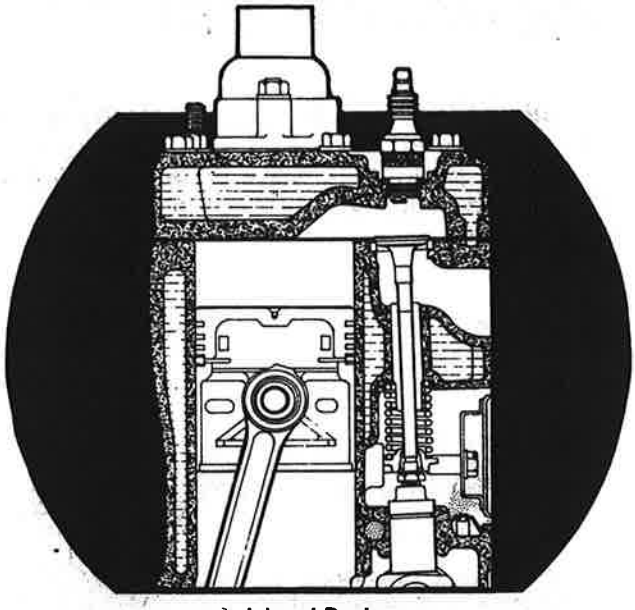
Typical Nameplate

Section 1 - General Information

L-Head engines have inherent design advantages which result in a more simple engine of lower height, weight and cost. All valves, cams, valve lifters and all other moving parts are a part of the cylinder block assembly.

The cross section of an L-Head engine resembles the letter "L" written upside down.

Intake and exhaust valves are located in the side pocket and both are directly operated through tappets from a single camshaft. This provides a simple and heavy duty valve gear, since there is no deflection.



L-head Design

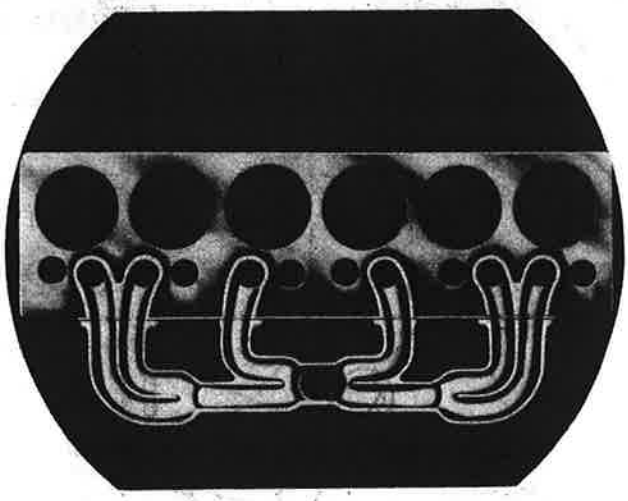
CONTINENTAL L-HEAD ENGINES

Continental has one two-cylinder, two four-cylinder and two six-cylinder L-Head type engines, ranging in size from 56 to 244 cubic inch displacement.

The combustion chamber design has been tailored for the required turbulence, charge flow and burning characteristics to provide dependable and economical heavy duty service.

Some of the principal design features are:

1. **Individual Porting** — of the intake manifold whereby each cylinder is fed with the fuel-air mixture individually and not influenced by other cylinders of the engine.

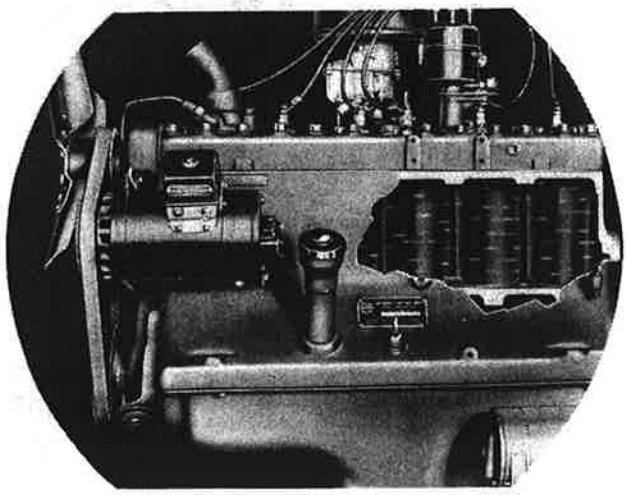


Individual Porting

This is accomplished by casting the cylinder block with individual intake valve passages for each cylinder and connecting these passages to an intake manifold which also has individualized passages for each cylinder.

This equal distribution results in maximum power, smooth operation, easy starting and longer engine life.

2. **Full Length Water Jackets** — completely surround all cylinder bores the full length of the piston ring travel.



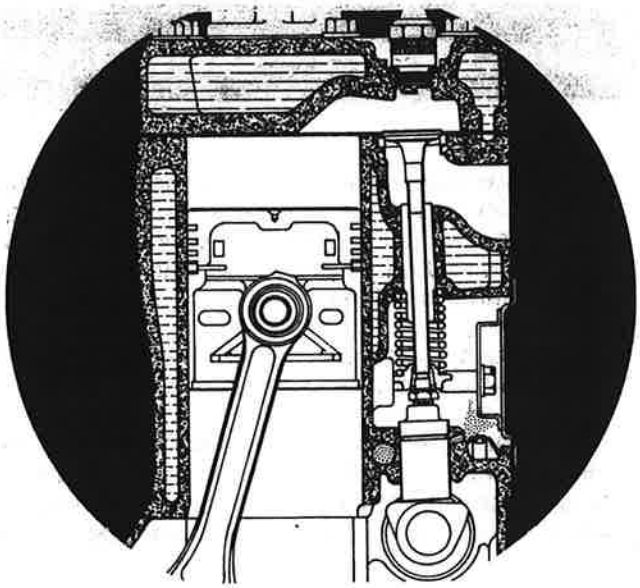
Full Length Water Jackets

This insures uniform cooling with minimum bore distortion — which results in lower oil consumption: less blow-by and minimum tendency to sludge.

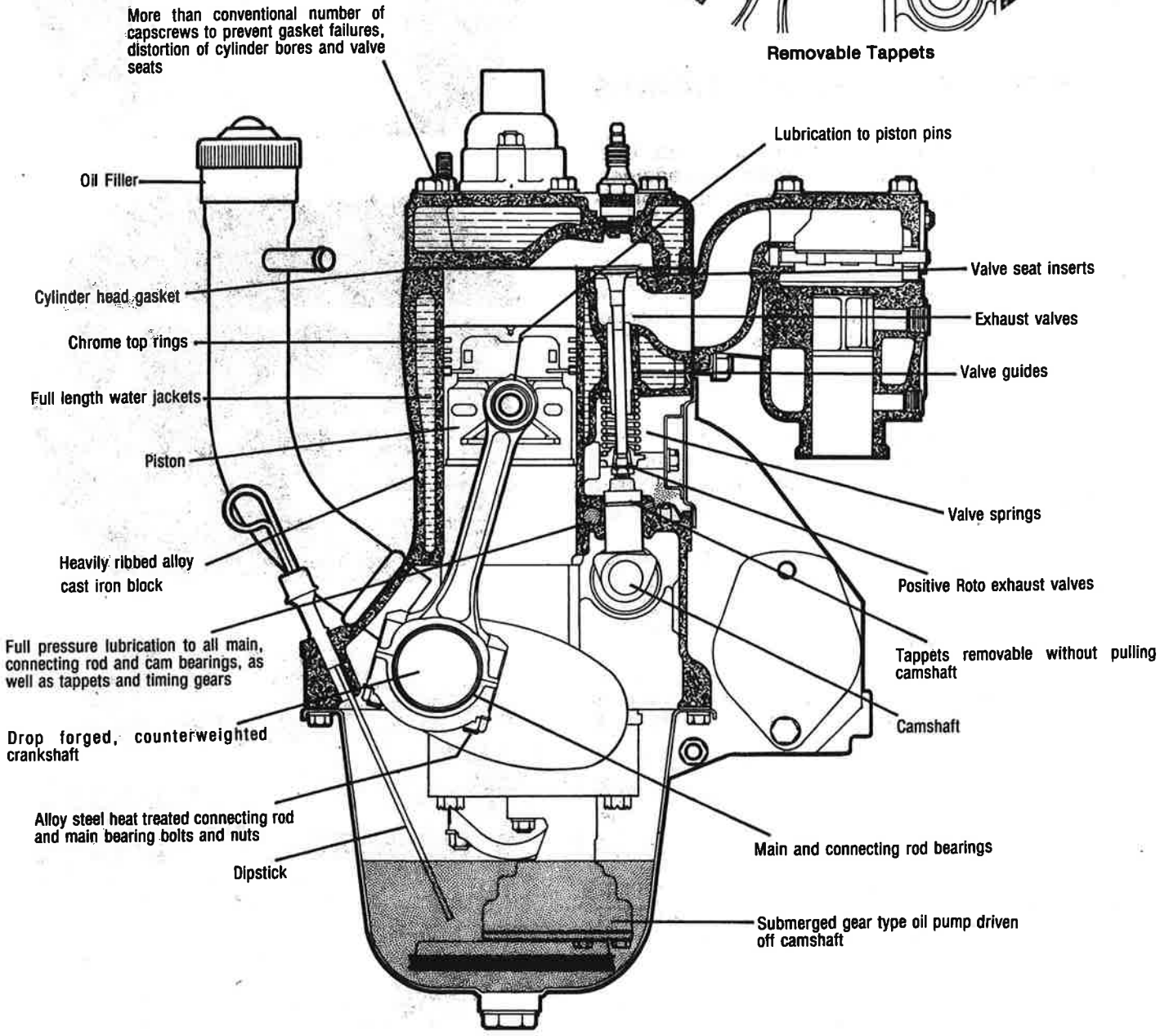
3. **Removable Tappets** — The large, barrel shaped, pressure lubricated tappets are so designed that by removing the adjusting

screw — the main body can be lifted out and replaced from above through the valve chamber. This eliminates the costly service operation of dropping the oil pan and pulling the camshaft. Locking of the adjustment is both simple and effective.

4. **Choice of Fuels** — Continental L-Head engines have been tailored for heavy-duty operation for use either with gasoline - LPG - natural gas and non-leaded fuels that meet a minimum octane of 85 motor method.



Removable Tappets



Cross Section of a Typical Continental L-Head Engine

Section 2 - Operating Instructions

The person operating the engine naturally assumes responsibility for its care while it is being operated. This is a very important responsibility since the care and attention given the engine goes a long way in determining how long a period it will operate satisfactorily before having to be shut down for repairs.

The operating and preventive maintenance instructions for the L-Head type engines are simple and should be followed without deviation.

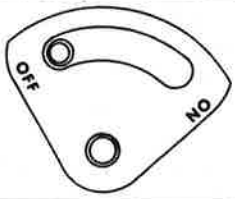
The entire aim in setting forth these instructions is to give you the benefit of the knowledge and experience gained over a long period of collaboration between Engineering Research and Field Service.

PREPARATION OF A NEW ENGINE FOR OPERATION

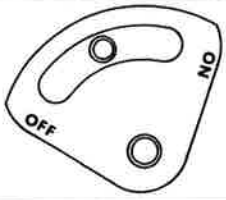
Before placing a new engine in operation, it must be thoroughly inspected for external damage and particular attention paid to the following items:

1. **Inspect Engine Hold Down Bolts** — To make certain that they are firmly set.

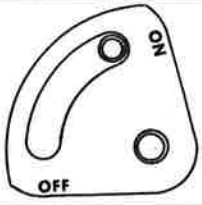
2. **Manifold Heat Valve Setting** — Some "F" series industrial engines have an adjustable sector on the exhaust manifold which can provide added heat on the intake manifold for **light operations with excessive idling.**



OFF POSITION
NORMAL OPERATION
(Above 50° F.)
75% to full load operation and all LPG usage.



1/2 ON POSITION
LOW SPEED - LIGHT LOAD
(32° F. to 50° F.)30-75% of load operation

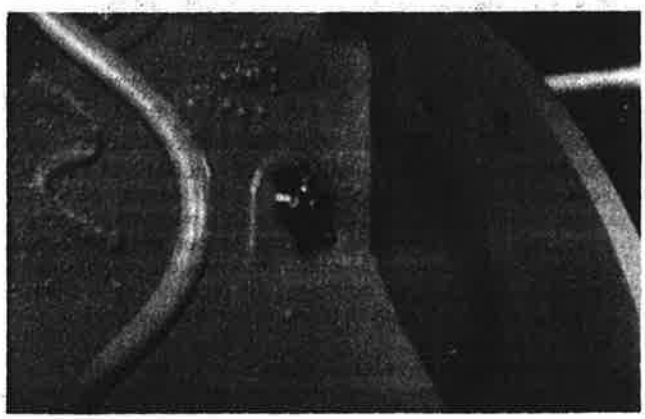


FULL ON POSITION
LIGHT LOAD - EXCESSIVE IDLING (Below 32° F.)
Below 30% load operation

CAUTION: If black smoke is in evidence, indicating a rich mixture, the heat should be increased by increments to correct; if loss of power (lean mixture) is in evidence, the heat should be decreased until the correct mixture is obtained.

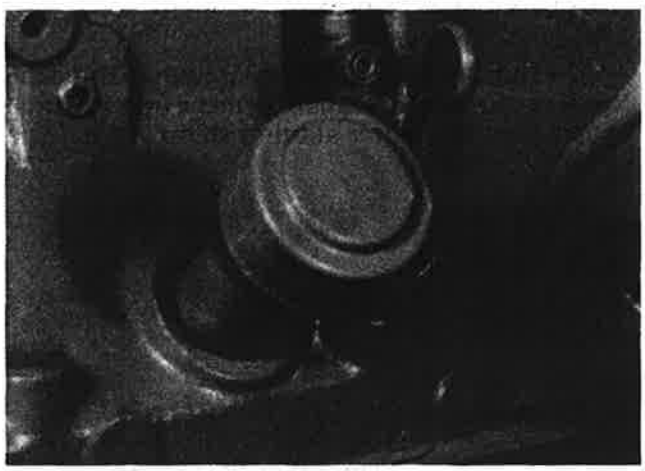
In many cases, rough running or lack of power plus carburetor icing can be corrected by adjustment of this heat riser valve as noted above.

3. **Close water drain cock** — on the side of the block. (In some cases, this may be a pipe plug.)



Water Drain Cock

4. **Fill Crankcase with oil** — Use the oil recommended for the ambient temperature (see chart on page 14).



Oil Filler Tube

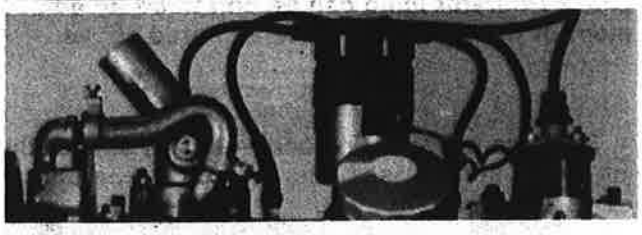
5. **Engine Accessories** — see that all points requiring lubrication are properly lubricated.

6. **Electrical Connections** — check storage battery terminals and all electrical connections. Check each spark plug wire for tightness.

⚠ WARNING

Stop engine before checking battery terminals or electrical connections. Do not hold ignition wires with bare hands since shocks or other injuries can result. Sparks or flames near a battery could cause an explosion or fire. Battery acid can cause corrosive burns. Always wear eye protection. Use of jumper cables or battery charging should be done only as directed by manufacturers safety instructions.

Read and observe safety warnings on pages 1 and 2.



STARTING THE ENGINE

⚠ WARNING

Bodily injury or death may result to individuals during operation of an engine within any enclosure not adequately or properly ventilated. Engine operation in any enclosure requires adequate and proper ventilation to avoid asphyxiation or other interruption of normal breathing, to supply sufficient air to cool the engine, provide air to mix with fuel and to carry away heated air from the building.

Read and observe safety warnings on pages 1 and 2.

Normally check daily preventive maintenance schedule before starting. — (See section 8)

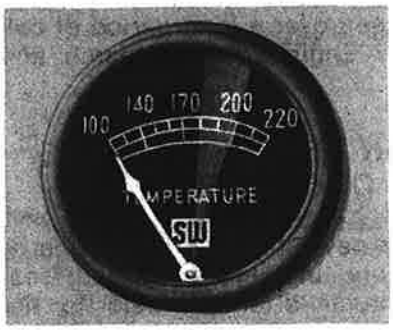
1. **Disengage Power Take-Off** — (if equipped) Starting engine under load throws overload on starter and battery.
2. **Open Throttle Control** about 1/3 open
3. **Turn on Ignition Switch**
4. **Pull Out Choke** (if manually operated) But avoid flooding the engine. Operate the engine without choking as soon after starting as possible.

Typical Instrument Panel

5. **Push Starter Button In** — Keep on until engine starts; but not longer than 15 seconds at a time.
6. **Warm-up Before Applying Load** — Idle the engine at 600-1000 R.P.M. for a few minutes to circulate and warm oil — then increase the speed to approximately half throttle until the engine water reaches 100° F. This procedure will prolong the engine life.
7. **Check Oil Pressure**

MODEL	OIL PRESSURE
F Series (with 10EL00230 oil pressure relief spring)	30-40#
TC-Y Series	30-40#

8. **Check Water Temperature**



Water Temperature Gauge

9. **Check Ignition timing** (400-500 R.P.M. At T.D.C. or as otherwise specified.)
10. **CAUTION:** After starting new engine — run it at idle for 5 minutes, then stop engine and recheck oil level in crankcase — then bring oil level to high mark on dipstick.

IMPORTANT! Breaking in a new or rebuilt engine — for peak performance and economical operation, the following adjustments should be made at end of first 50 hrs. operation.

1) Torque down cylinder head cap screws to specification.
2) Adjust valve tappets to specified clearances.
3) Adjust idle mixture and idle speed to 400-600 R.P.M. for the "Y" and "F" engines and 800 R.P.M. for the TC56 engine.

WARM UP NEW ENGINES

When new engines in distributors or dealers stock, showrooms, etc. are started up for any reason, *they should be brought up to operating temperature in order to eliminate all condensation before stopping.*

If they are stopped while still cold, condensation will settle on valve stems and guides, as well as other moving parts, and rust and sludge will form. Soon valves, rings, etc. will be stuck by this rusting and sludging action.

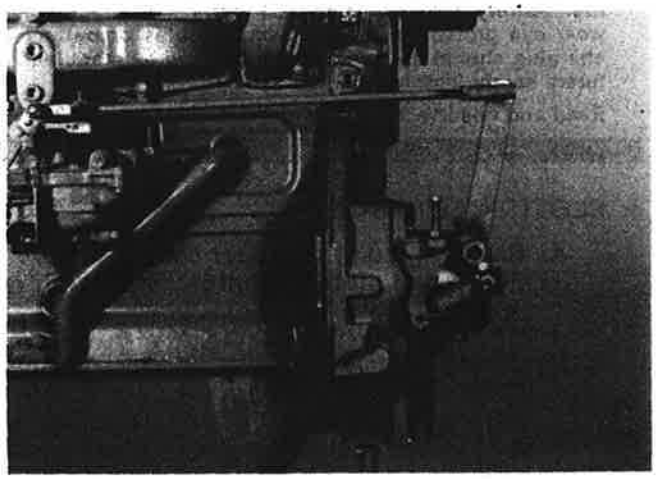
Engine should be operated long enough to bring oil and water temperature to normal operating temperature; *be sure breather or ventilation system is open so vapor can be expelled.*

SPEED CONTROL

The throttle control is used to close the carburetor butterfly valve to limit engine speed below governed speed.

Engines are provided with a mechanical or velocity governor set to maintain the load and speed specified when the engine is ordered. If individual requirements necessitate a change of governed speed — reset governor as outlined under "Governor adjustment", but do not exceed manufacturer's recommended maximum speed, since this has been worked out with the end product requirements in mind.

When extended periods occur between the applications of load, it is recommended that the engine be throttled down to minimum idling speed or, if the intervals are unusually long, that it be shut down.



Throttle Lever
(This may vary with the application)

STOPPING THE ENGINE

1. **Disengage Power Take-Off**

2. **Reduce engine Speed to Idle** — If hot, run engine at idle for several minutes to cool.

3. **Turn off Ignition Switch** — If engine continues to run due to high combustion chamber temperatures, either continue idling to further cool or shut off fuel supply.

CAUTION: NEVER PULL OUT CHOKE WHEN STOPPING ENGINE — BECAUSE RAW GASOLINE WILL WASH LUBRICANT FROM CYLINDER WALLS.

11 "MUSTS" FOR YOUR GASOLINE ENGINE

1. OIL PRESSURE - should be up to recommended pressure at operating speed and over 7 pounds at idle (400-600 R.P.M.) for the "Y" and "F" engines and (800 R.P.M.) for the TC56 engine.

2. AMMETER - should register "Charging" at all times engine is running. (A voltage regulator may limit it to a very low reading).

3. WATER TEMPERATURE - normal operation 178-205°F., pressure cap determines higher temperatures. Overheating is detected by loss of coolant. "FREQUENT READINGS OF GAUGE SHOULD BECOME A HABIT".

4. MUFFLER RESTRICTION - should not exceed 20" water or 1-1/2" Mercury. Inspect mufflers periodically for restrictions to prevent burned valves.

5. CLEAN AND SERVICE AIR CLEANER - as recommended to maintain its efficiency.

6. WHEN ENGINE IS OVERHEATED - do not add water - allow engines to cool so as to prevent cracking the cylinder block.

7. ENGINE LOAD INDICATION - a manifold vacuum of 6 inches of Mercury indicates the recommended continuous full load operation and a vacuum of 18-20 inches of Mercury indicates normal idling vacuum. Between full load and idling, vacuum gauge readings may be used to approximate the percent load. Below 6" of Mercury indicates engine is overloaded for continuous duty.

8. AVOID COLD-SLUDGE CONDENSATION - by protecting unit to maintain *crankcase* temperature over 135°F. Use a proper temperature range thermostat and warm engine up thoroughly.

9. BREAKING IN A NEW OR REBUILT ENGINE - for peak performance and economical operation, the following adjustments should be made at end of first day's operation;
   1. Torque down cylinder head to specifications.
   2. Adjust valve tappets to specified clearances.
   3. Adjust idle mixture and idle speed to 400-600 R.P.M. for the "Y" and "F" engines and 800 R.P.M. for the TC56 engine.

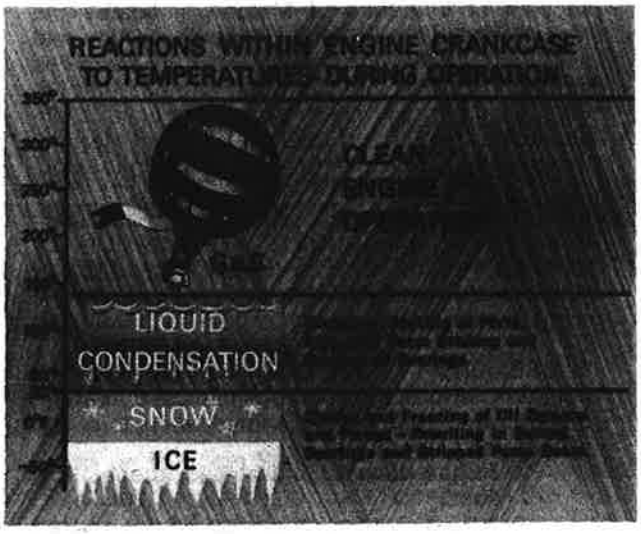
10. FOLLOW PREVENTIVE MAINTENANCE SCHEDULES RECOMMENDED - this will avoid troubles which might cause expensive breakdowns and maintain your engine for dependable and economical operation.

11. IDLING ENGINE - slow engine down to low idle (600 R.P.M.) for about 5 minutes, after each operating period, before stopping - too rapid cooling down may cause distortion. DO NOT RUN AT LOW IDLE FOR PROLONGED PERIODS.

COLD WEATHER OPERATION

The oil used during cold weather should have a cold test below the lowest anticipated temperatures that will be encountered during its use. The new multigrade lubricating oils 5W-20 and 10W-30 are ideal for cold starting with its reduced initial drag until warmed up, when it assumes the characteristics of the heavier oil.

Sludge formation at low temperatures is a close second to dirt in causing engine damage and wear. This is formed by the piston combustion gases mixing with the fine oil mist in the crankcase and condensing on a cold surface. This condensation forms both a sulphuric and sulphurous acid which combines with the oil to become a highly injurious sludge. This dew point is about 135°F. — when crankcase temperatures are higher, the contaminated gases remain in gaseous form and the engine operates clean as long as breather system is kept clean — however temperatures below this will result in injurious sludge formation. It is vitally important therefore to maintain oil and crankcase temperatures above 135°*F., as shown on the following chart:*



When sludging conditions prevail, the oil should be examined daily and changed as it may freeze, or clog the inlet strainer and cause bearing or oil pump failures.

High Altitude Operation — High Altitude operation reduces the power output approximately 3½% for every 1000 feet of altitude above sea level.

High Temperature Operation — for every 10° above 85°F. carburetor air temperature — a power loss of 1% results.

ENGINE PREPARATION FOR WINTER USE

More than 90% of the hard starting complaints in cold weather are the direct result of inadequate attention to preparation for winter use and proper maintenance. An engine not properly prepared and "out of tune" requires more cranking energy and time, which puts a heavy load on batteries. So, invariably, batteries run down and the engine is blamed for hard starting. Putting your engine in proper condition and keeping it that way pays big dividends by reducing costly down time.

Use the checklist which follows to get your engine ready for winter. Then use the winter maintenance schedule to keep it in peak operating condition during the winter months.

CHECKLIST

⚠ WARNING

Stop engine before checking battery terminals or electrical connections. Do not hold ignition wires with bare hands since shocks or other injuries can result. Sparks or flames near a battery could cause an explosion or fire. Battery acid can cause corrosive burns. Always wear eye protection. Use of jumper cables or battery charging should be done only as directed by manufacturers safety instructions.

Read and observe safety warnings on pages 1 and 2.

1. ELECTRICAL SYSTEM

   A. Battery - replenish water and test for condition and state of charge. Replace if required.

   B. Wiring - check battery cables, connections and other wiring. Be sure connections are clean and tight and that cables and wiring insulation are in good condition.

   C. Alternator and regulator - run the engine and check the ammeter to be sure the alternator is charging and the regulator is functioning properly. Check and adjust alternator belt tension.

⚠ WARNING

Magneto wires carry high voltage electrical current capable of giving a shock. If you grasp the molded wire, make sure it is well back of the open end using insulated pliers.

Read and observe safety warnings on pages 1 and 2.

   D. Check distributor or magneto points. Clean and adjust, or replace, as required. Oil as required. Clean, regap, or replace spark plugs as required. Check ignition harness for loose connections and frayed

insulation, repairing or replacing as required. Check and clean the inside and outside of the distributor cap. Remove the high tension lead from the coil tower and clean the coil tower. Be sure all weather-protective rubber caps are in good condition and firmly in place.

2. COOLING SYSTEM

⚠ WARNING

If the coolant is hot or if the engine has been running, loosen the pressure cap to the first stop and let the pressure out of the cooling system before removing the radiator cap.

Read and observe safety warnings on pages 1 and 2.

A. Check radiator, hoses and engine for water leaks. Tighten hose clamps, repair leaks and install antifreeze to the level required for winter protection.

3. LUBRICATION SYSTEM

A. Drain oil and change filter. Add oil of the proper winter grade.

B. If the unit employs a fluid coupling, torque converter, transmission or differential, check the instruction manuals for the proper winter grade lubricant and install it.

4. FUEL SYSTEM

A. Check the throttle and choke controls for satisfactory operation and adjust as required.

B. Check the carburetor and clean as required. Check and adjust the carburetor idle speed control.

5. EXHAUST SYSTEM

A. Check the rain cap if supplied, for proper operation and repair as required.

6. INTAKE AIR SYSTEM

A. Be sure all hoses and clamps are properly seated and tight.

B. Check instructions on the oil bath air cleaner. Clean and refill with the recommended winter grade of oil.

7. MISCELLANEOUS

A. If the engine is equipped with a preheater or cold starting aid, check the operation according to instructions, repair or adjust as required.

B. Check and adjust tappets.

WINTER MAINTENANCE

1. Perform maintenance in accordance with instruction manuals.

2. Change oil at least every thirty days.

3. If unit is only used for short periods and does not get thoroughly warm, operate it for at least an hour once a week to get it thoroughly warm. This will avoid excessive sludge in the oil and reduce dilution of oil with raw fuel in the crankcase.

PREPARATION OF ENGINE FOR SEASONAL STORAGE

(90 DAYS TO 6 MONTHS)

CAUTION: Before starting the processing, engine must be cooled down to the surrounding temperature, since oil will adhere much better to cold metal surfaces.

1. **Drain Oil from Oil Pan** — and replace drain plug.

2. **Refill Oil Pan** — with high grade SAE 30 or 40 engine oil to 1/2 its normal capacity.

3. **Start Engine** — and run above 600 R. P. M. for 2 minutes to complete oil distribution on all surfaces — **Do Not Run Longer Than 2 Minutes.**

4. **Stop Engine** — Remove all Spark Plugs.

5. **Pour 3 Ounces of SAE 30 or 40 Engine Oil** — into each Spark Plug Hole.

6. **With Ignition Cut Off — Crank engine with Starter** — for at least a dozen revolutions to distribute this oil over the cylinder walls and valve mechanism.

7. **Drain Oil from Pan and Reassemble Plug.**

8. **Drain Cooling System and Close Drain Cocks.**

⚠ WARNING

Smoking or open flame should be avoided any time the fuel system is being repaired or serviced. The area should be properly ventilated. Improper handling of fuel could result in an explosion or fire causing bodily injury to yourself or others.

Read and observe safety warnings on pages 1 and 2.

9. **Drain All Gasoline** — from tanks, lines and carburetor bowl.

10. **Replace All Spark Plugs.**

11. **Seal Air Cleaner Inlet — Exhaust Outlet — Crankcase Breather Tube** — with weather proof masking tape.

12. **Check Oil Filler Cap — Gas Tank Cap and Radiator Cap** to make certain they are securely in place.

Note: If Mil-L21260 No. 30 oil is available, substitute in Steps 2 and 5.

SHORT TERM STORAGE

(30 TO 90 DAYS)

If the shut down period is to be over 30 days duration, the following instructions should be adhered to:

1. Stop engine, remove spark plugs.

2. Pour 3 ounces clean engine oil in each spark plug hole.

3. With ignition cut off, crank engine with starter at least a dozen revolutions to distribute this oil over the cylinder walls and valve mechanism.

4. Replace all spark plugs.

5. Remove drain plug from carburetor bowl, and drain gasoline.

6. Replace drain plugs.

Caution: Gasoline evaporates if left in carburetor for long periods. This evaporation of gasoline will leave a gum and varnish coating over jets and moving parts: when engine is started up again, you may have flooding or poor operation from carburetor.

NOTES

Section 3 - Lubrication

ENGINE LUBRICATION SYSTEM

Continental L-Head engines have full pressure lubrication to all main, connecting rod and camshaft bearings as well as tappets and timing gears.

OIL PUMP

On all engines, a large capacity, submerged, gear type oil pump is driven off the camshaft and protected by a large screen inlet.

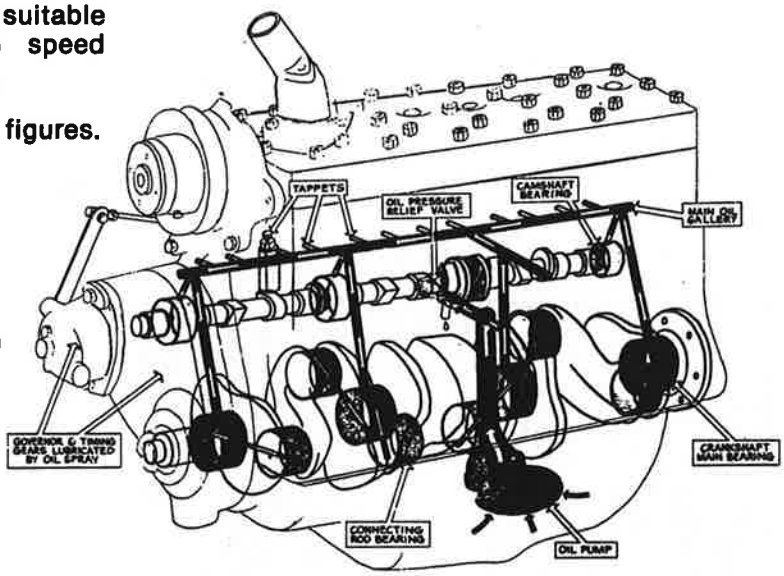
An adjustable by-pass valve maintains suitable oil pressure from idle to maximum speed automatically.

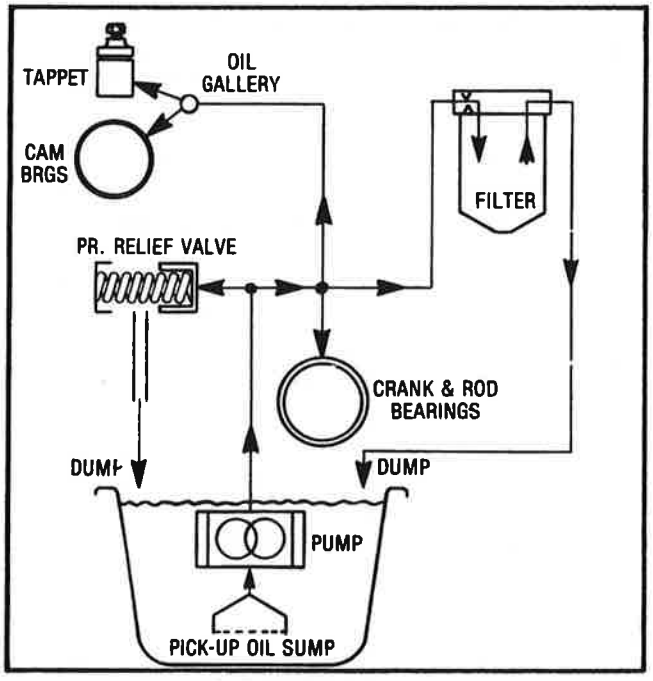
Refer to page 4 for complete oil pressure figures.

CAUTION: If the oil pressure is erratic or falls below these limits, stop the engine IMMEDIATELY and find the cause of the trouble. Refer to trouble shooting section for this information.

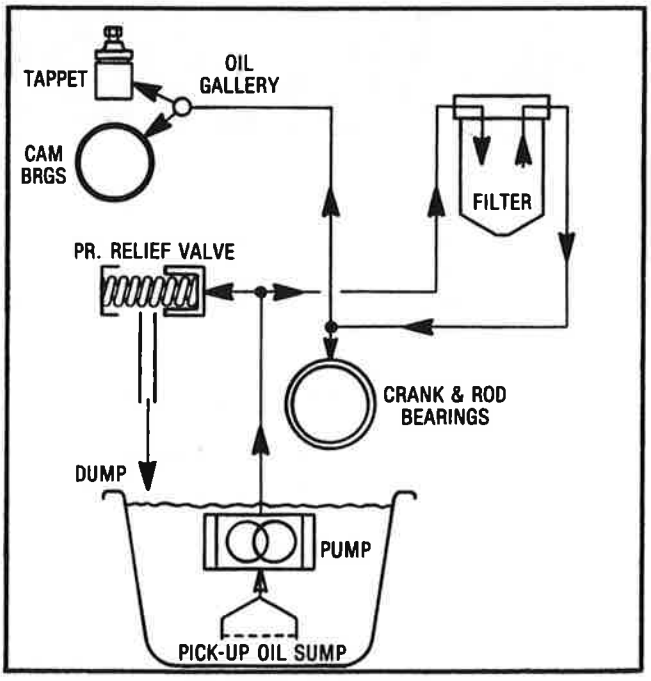
Either by-pass type or full flow oil filters are provided to remove dirt and foreign elements from the oil. The removal of grit, sludge and foreign particles causes filter elements to clog and become ineffective unless they are normally replaced every 150 hours.

Oil Flow Diagram

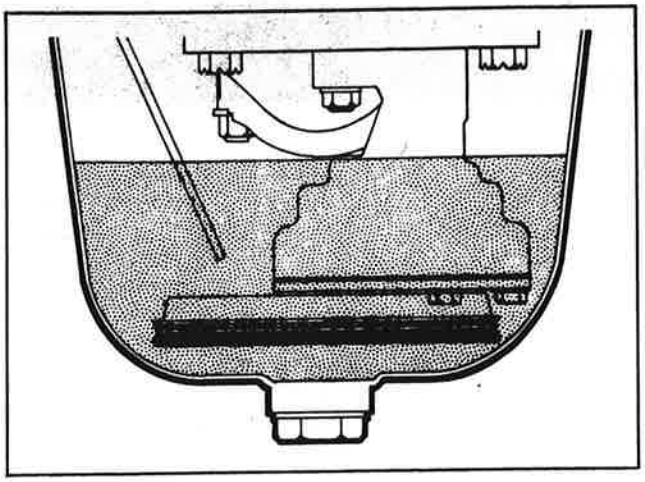




By-Pass Filter System



Full-Flow Filter System



Oil Pump

OIL CHANGE FREQUENCY

Engine oil does not "wear out". However, the lubricating oil in internal-combustion engines be comes contaminated from the by-products of combustion: dirt, water, unburned fuel entering the crankcase, and the detergents holding the carbon particles in suspension in the crankcase.

Oil Filter

The schedule for changing oil is directly dependent upon the operational environment: an extremely clean operation could go 150 hours while a dirty operation (foundry or cement factory) could be 50 hours **or less.**

LUBRICATION RECOMMENDATIONS

Motor oils used for internal-combustion engine lubrication perform many useful functions including: Dissipating heat, sealing piston rings, preventing metal-to-metal contact wear and reducing power loss through friction.

The lubricating oil recommendation is based upon engine design, type of service, and the atmospheric temperature prevailing. High quality oils are required to assure maximum performance, long engine life, and minimum cost of operation.

L-Head gasoline engines operate in a wide range of service conditions and seasonal temperatures, so our recommendations are given for various types of service and ambient temperatures.

API SERVICE DESIGNATIONS

We recommend using oil described below for all L-Head engine applications (Gasoline - LPG - Natural Gas).

SE - SERVICE CLASS E

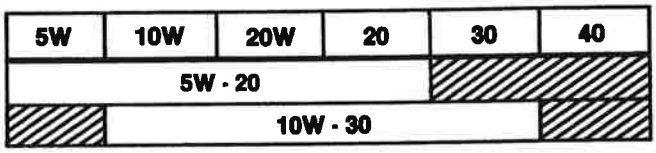
Service typical of industrial gasoline engines operating under engine manufacturers' warranties. Oils designed for this service provide more protection against oil oxidation, high temperature engine deposits, rust and corrosion in gasoline engines than oils which are satisfactory for API Engine Service Classifications SD or SC.

OIL TYPE

SE - High Detergent - Exceeds engine manufacturer warranty requirements.

S.A.E. OIL BODY GRADES

The oil body grades available from the lightest (SAE 5W) to the heaviest (SAE 40) are:



Multi-Grade Oils such as SAE 5W-20 and SAE 10W-30 have the starting grade characteristics of the lighter oil and after warm up have the running characteristics of the heavier grade.

The following SAE grades are general recommendations for Continental L-Head engines during changing seasonal atmospheric temperatures:

ENGINE SERIES	SEVERE WINTER BELOW 0°F.	NORMAL WINTER 0°32°F.	SPRING-FALL 32°-76°F.	SUMMER ABOVE 75°F.
TC, Y, F	SAE 5W-20	10W	SAE 20W	SAE 30

The Multi-Grade oil used should cover the single grade recommendation for the atmospheric temperature involved, e.g. SAE 10W-30 covers SAE -10W, SAE-20W, SAE 20 and SAE 30.

Generators, Starters, Distributors - Add 3-5 drops (if required) of engine oil to the generator and starter oil cups every 50 hours and to the distributor every 250 hours.

Section 4 - Cooling System

The function of the cooling system is to prevent the temperatures in the combustion chamber, which may reach as high as 4000°F., from damaging the engine and at the same time keep the operating temperatures within safe limits.

Maintaining the cooling system efficiency is important, as engine temperatures must be brought up to and maintained within satisfactory range for efficient operation; however, must be kept from overheating, in order to prevent damage to valves, pistons and bearings.

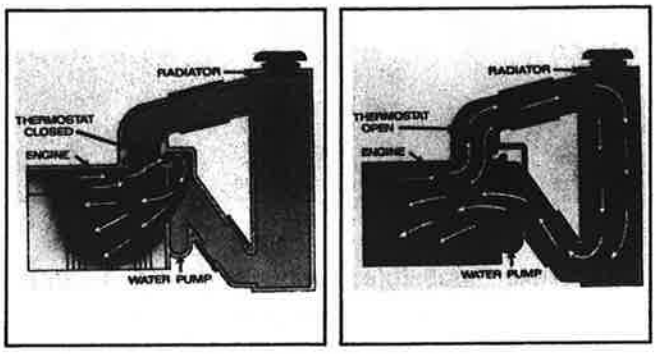
CONTINENTAL L-HEAD COOLING SYSTEM

All Continental L-Head engines have the cooling water force-circulated by a water pump and use a thermostat and by-pass system to control the temperature range.

The coolant from the water pump is first directed in the block against the exhaust valve seats and into passages connecting the cylinder head. This method provides the coldest water reaching the parts subjected to the highest temperatures.

Upon leaving the cylinder head, the water enters the thermostat housing, in which is mounted the by-pass type thermostat, which controls the opening to the radiator or heat exchanger. Upon being discharged from the thermostat housing, the water enters the radiator or heat exchanger, depending upon the application, where it is cooled before re-entry into the engine.

Continental L-Head gasoline engines operate most efficiently with water temperatures of 180°-200°F. and a thermostat and by-pass system is generally used to control these temperatures.



Thermostat Flow Control

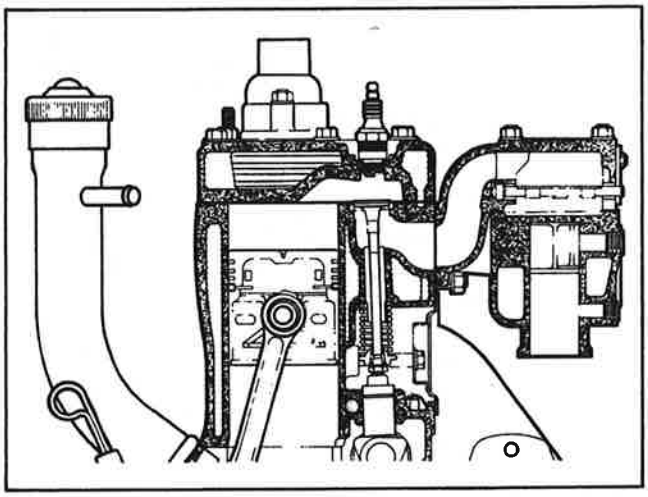
Thermostat Closed, Water Re-Circulating through Engine Only

Thermostat Open, Water Circulating through Both Engine and Radiator

The thermostat valve remains closed and only allows the water to recirculate within the engine itself until normal operating temperatures are reached. This provides for both rapid and even temperature increase of all engine parts during the warm-up period. When desired temperature is reached, the thermostat valve opens and allows the water to circulate through both the engine and radiator.

IMPORTANT: Present thermostats begin to open at 180° F. and are fully open at 202° F. Operation of engines in this temperature range is not harmful. However, temperature gauges are not always accurate and may sometimes indicate higher than actual temperature. This can lead operators to believe engines are overheating when they are actually operating normally.

Overheating is always accompanied by loss of coolant water. In case of doubt, this should be checked.



Sectional View Showing Water Passages in Head and Block

EXPANSION OF WATER

Water has always been the most commonly used coolant for internal combustion engines because it has excellent heat transfer ability and is readily obtained everywhere. Like all liquids it expands when heated, the rate of expansion being 1/4 pint per gallon when the temperature is raised from 40° to 180° F.

For example: If a 4 gallon cooling system is filled completely full of water at 40° F, 1 pint will be lost through the radiator overflow pipe by the time the water temperature reaches 180° F.

WATER FILTERS

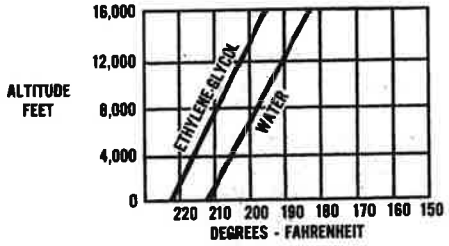
In some areas, the chemical content of the water is such that even the best of rust inhibitors will not protect the cooling system from the formation of rust and scale.

There are instances where this corrosive element has eaten holes through cast iron parts such as water pump impellers and bodies. This condition is caused by electrolysis taking place in the parts involved.

Where these conditions exist, water filters, should be incorporated in the assembly to remove these troublesome elements and offset the electrolytic action.

EFFECT OF ALTITUDE ON COOLING

Water boils at 212° F. under atmospheric pressure at sea level. This pressure becomes less at higher altitudes and the reduced pressure causes water and other liquids to boil at a lower temperature. The following chart shows the effect on boiling point of water and anti freeze solution:



Comparison between Coolant Boiling Points of Water and Ethylene Glycol

ANTI-FREEZES

Water freezes at 32° F., forms solid ice and expands about 9% in volume — which causes tremendous pressure and serious damage when allowed to freeze inside the cooling system.

When operating temperatures are below 32° F. an anti-freeze liquid must be added which will lower the freezing point a safe margin below the anticipated temperature of outside air.

ANTI-FREEZE	OPERATING TEMPERATURE RANGE		
	32° to 10° F	+10° to -10° F	-10° to -30° F
ETHYLENE GLYCOL (permanent type) — When there are no leaks add water only to make up for evaporation.	Ratio Ethylene Glycol to water		
	1 to 4	2 to 5	1 to 1

CORROSION INHIBITORS

⚠ WARNING

Corrosion inhibitor can cause damage to the eyes or skin. If contact is made, immediately wash skin with water. For the eyes, immediately flush the eyes with water for several minutes. In either event, seek prompt medical attention.
Read and observe safety warnings on pages 1 and 2.

Water forms rust due to its natural tendency to combine chemically with iron and air in the system. Rust inhibitors for water are inexpensive, simple to use and make cleaning and flushing necessary only after long periods of operation.

The addition of a corrosion inhibitor is not necessary if an anti-freeze containing a rust inhibitor is used.

RADIATOR

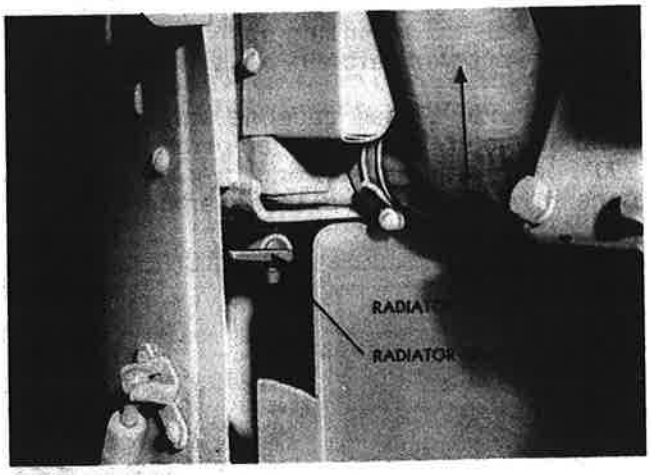
The radiator or heat exchanger consists of a series of metal tubes through which the cooling water is circulated. In standard radiator design fins are connected to the metal tubes to give an extended surface through which heat can be dissipated. It is important that these tubes be kept clean on the inside and the fins free of dirt on the outside so that maximum heat transfer can take place in the radiator.

⚠ WARNING

If the coolant is hot or if the engine has been running, loosen the pressure cap to the first stop and let the pressure out of the cooling system before removing the radiator cap.
Read and observe safety warnings on pages 1 and 2.

Blowing out between the fins of the radiator, using compressed air, in a direction opposite to that of the fan circulated air, will serve to keep the cooling surfaces of the core free of dirt and other particles. Operating conditions will determine the frequency of this service.

Every 500 hours of operation the radiator and cooling system should be well cleaned and flushed with clean water. (See Radiator Drain.)



Radiator Drain

Wherever possible, only soft clean water should be used in the cooling system. Hard water will cause scale to form in the radiator and the engine water jackets and cause poor heat transfer. Where the use of hard water cannot be avoided an approved water softener can be used.

CLEANING COOLING SYSTEM

Deposits of sludge, scale and rust on the cooling surfaces prevent normal heat transfer from the metal surfaces to the water and in time render the cooling system ineffective to properly maintain normal operating temperatures. The appearance of rust in the radiator or coolant is a warning that the corrosion inhibitor has lost its effectiveness and should be cleaned before adding fresh coolant.

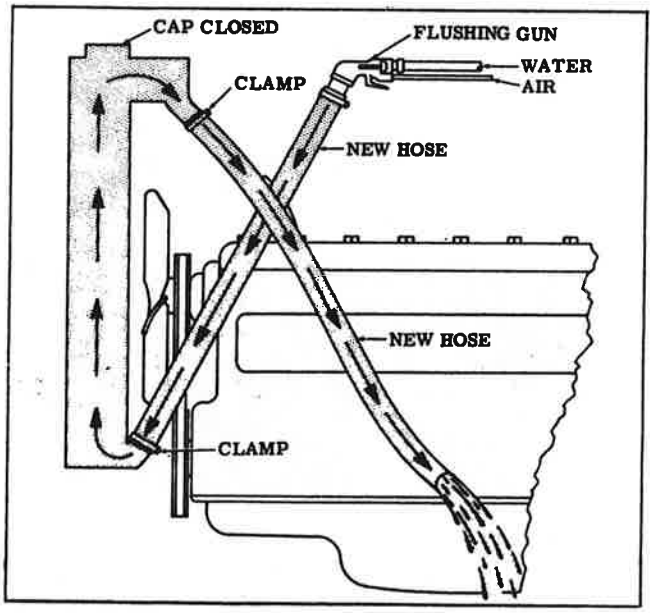
Dependable cleaning compounds should be used. Follow the procedure recommended by the supplier. This is of prime importance because different cleaners vary in concentration and chemical compositions. After cleaning and flushing, the system should be filled with an approved anti-freeze compound containing a rust and corrosion inhibitor or water with a corrosion inhibitor.

REVERSE FLOW FLUSHING

Whenever a cooling system is badly rust-clogged as indicated by overflow loss or abnormally high operating temperatures, corrective cleaning by reverse flow flushing will most effectively remove the heavy deposits of sludge, rust and scale. The reverse flow flushing should be performed immediately after draining the cleaning solution and it is advisable to flush the radiator first, allowing the engine to cool as much as possible.

Reverse flush the radiator, as follows:

1. Disconnect the hoses at the engine.
2. Put radiator cap on tight.
3. Clamp the flushing gun in the lower hose with a hose clamp.
4. Turn on the water and let it fill the radiator.

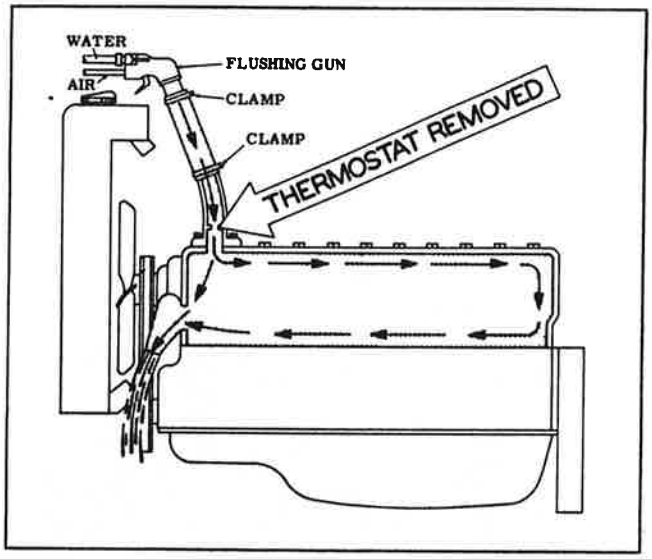


Reverse Flushing Radiator

5. Apply air pressure gradually, to avoid radiator damage.
6. Shut off the air, again fill the radiator with water and apply air pressure — repeat until the flushing stream runs out clear.
7. Clean and inspect radiator cap.

To Reverse flush the engine water Jacket

1. Remove the thermostat.
2. Clamp the flushing gun in the upper hose.
3. Partly close the water pump opening to fill the engine jacket with water before applying the air.
4. Follow the same procedure outlined above for the radiator by alternately filling the water jacket with water and blowing it out with air (80# pressure) until the flushing stream is clear.



Reverse Flushing Engine

TESTING THERMOSTAT

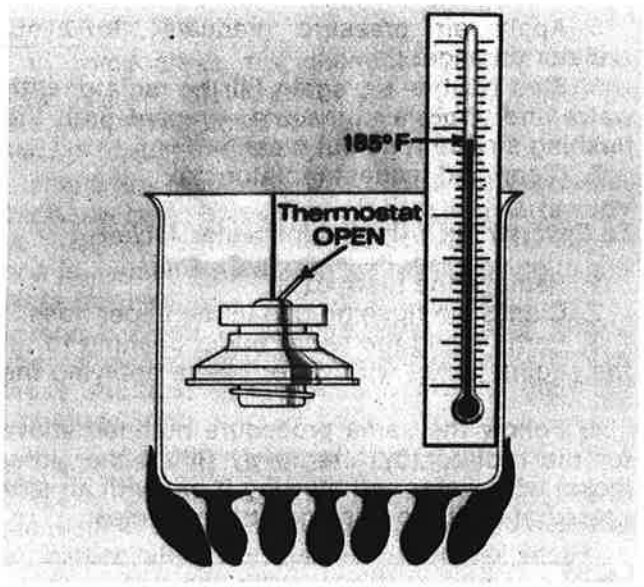
Remove water outlet elbow as shown in illustration. Before testing, clean and examine the bellows for rupture or distortion. If the valve can be pulled or pushed off its seat with only a slight effort when cold or it does not seat properly, the unit is defective and should be replaced.

The thermostatic operation can be checked in the following method:

1. Hang thermostat by its frame in a container of water so that it does not touch the bottom.
2. Heat the water and check temperature with a thermometer.

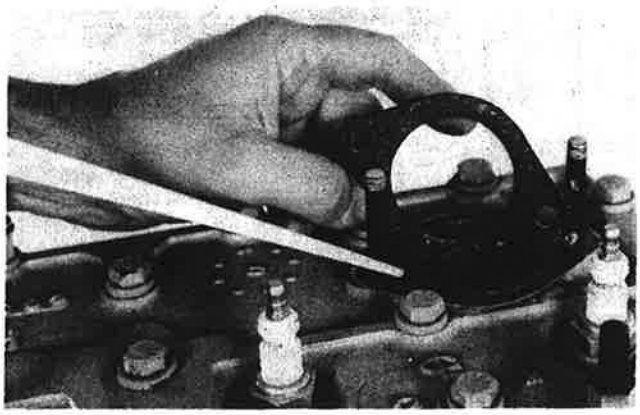
3. If the valve does not start to open at temperatures of 180°-200° F. or if it opens well before the 180° point is reached, the thermostat should be replaced.

When replacing the thermostat in the water outlet elbow, be sure the **counterbore and all machined surfaces** are clean.



Checking Thermostat

Assemble new water outlet elbow mounting gasket. Thermostat flange must seat in counterbore with gasket sealing contact between it and the cylinder head.



Installing New Gasket

When installing a new thermostat in the water outlet tube, make sure that the temperature sensing unit goes in last or faces toward the cylinder head.

Thermostat Retaining Ring

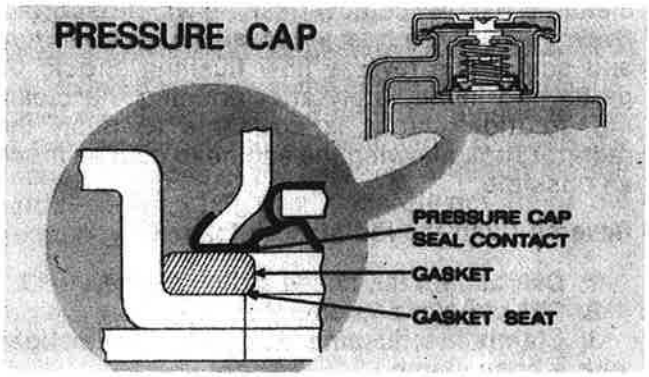
RADIATOR PRESSURE CAP

⚠ WARNING

If the coolant is hot or if the engine has been running, loosen the pressure cap to the first stop and let the pressure out of the cooling system before removing the radiator cap.

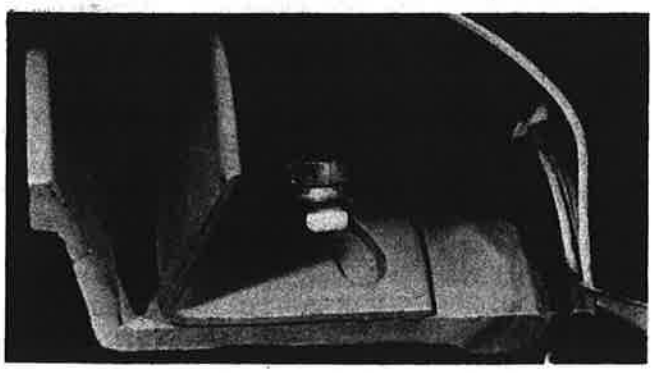
Read and observe safety warnings on pages 1 and 2.

Many operations use a pressure cap on the radiator to prevent overflow loss of water during normal operation. This spring loaded valve in the cap closes the outlet to the overflow pipe of the radiator and thus seals the system, so that pressure developing within the system raises the boiling point of the coolant and allows higher temperatures without overflow loss from boiling. Most pressure valves open at 4 1/2 or 7 pounds, allowing steam and water to pass out the overflow pipe, however, the boiling point of the coolant at this pressure is 224° F. or 230° F. at sea level. When a pressure cap is used an air tight cooling system is necessary with particular attention to tight connections and a radiator designed to withstand the extra pressure.



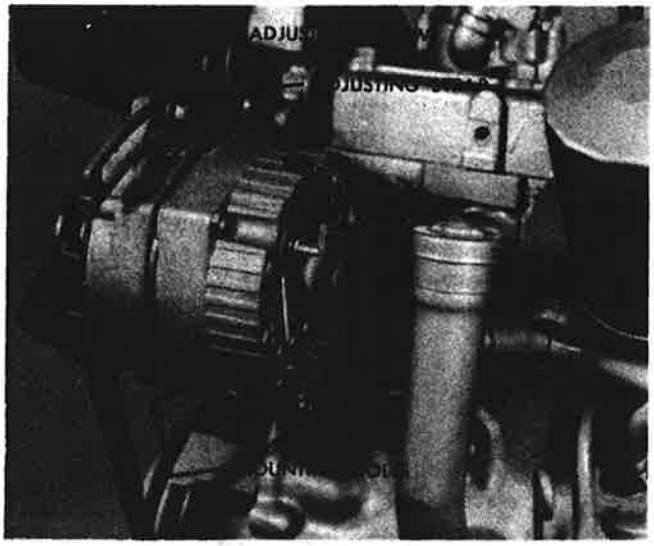
FAN BELT TENSION

When tightening fan belts, loosen the alternator adjusting bolts and pull out on the alternator by hand until the belt is just snug. Under no circumstances should a pry bar be used on the alternator to obtain fan belt tension or damage to the bearings will result. Some engines have an adjustable fan pulley flange for belt adjustment.



Fan Belt Adjusting Flange

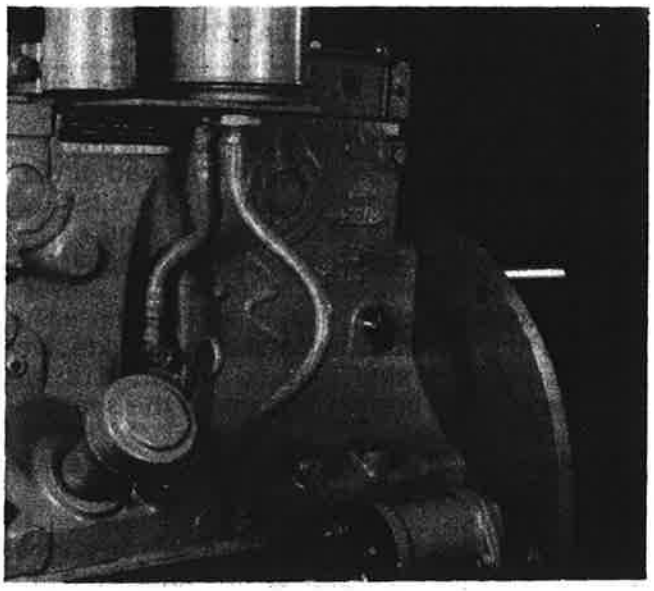
When adjusted correctly the fan belt deflection on the long side should be 3/4" to 1". (On narrow belts this should not exceed 1/2".)



Adjusting Fan Belt Tension

CYLINDER BLOCK WATER DRAINS

When the cooling system is to be completely drained, there are one or two drain plugs on the left hand side of the cylinder block which drain all cooling water which might be trapped in the base of the block.



CAUTION: OVERHEATED ENGINE Never pour cold water or cold anti-freeze into the radiator of an overheated engine. Allow the engine to cool and avoid the danger of cracking the cylinder head or block. Keep engine running while adding water.

WATER PUMP

The water pump is located in the front of the cylinder block and is driven by the fan belt from the crankshaft pulley. The inlet of the water pump is connected to the lower radiator connection and the outlet flow from the pump is through integral passages cast in the block.

No lubrication of the pump is required as the bearings are of the permanently sealed type and are packed with special lubricant for the life of the bearing.

The water pump requires no attention other than bearing replacement when they show excessive looseness or if a water leak develops which shows a damaged or badly worn seal that needs replacement.

⚠ WARNING

Corrosion inhibitor can cause damage to the eyes or skin. If contact is made, immediately wash skin with water. For the eyes, immediately flush the eyes with water for several minutes. In either event, seek prompt medical attention.

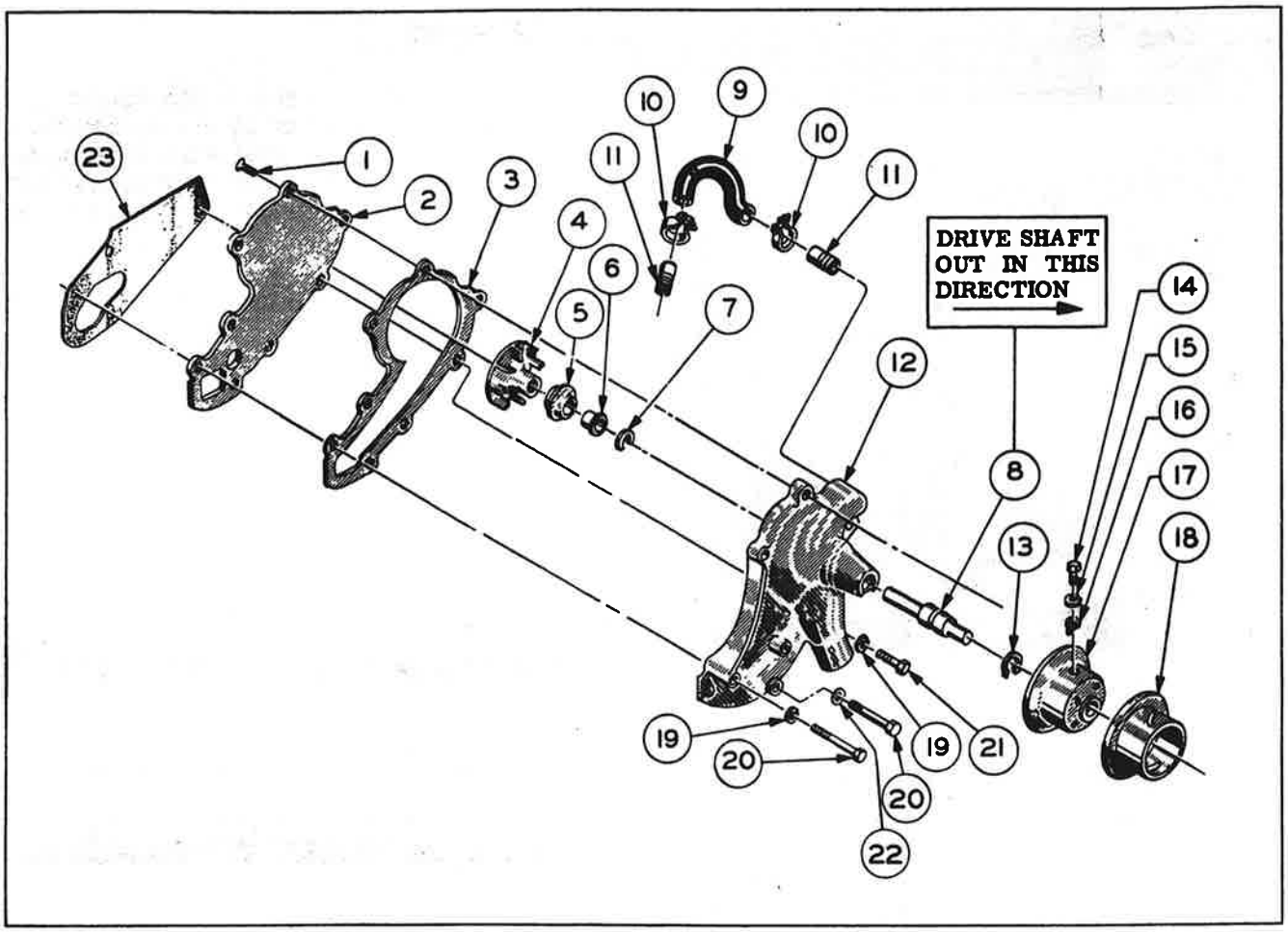
Read and observe safety warnings on pages 1 and 2.

REMOVING WATER PUMP

The water pump assembly can be removed from the engine as a unit for service or repair in the following manner:

1. Remove fan by taking out four cap screws.
2. Loosen alternator so that fan belt can be slacked off enough to slide over pulley.
3. Remove fasteners holding the pump body to the front of the block and remove the pump assembly.

Removing Water Pump



Disassembling Water Pump

DISASSEMBLY OF WATER PUMP

When replacement of any internal parts becomes necessary, **disassembly must be in the following sequence in order to prevent damage to the pump.**

1. Use puller to remove fan hub (17) from shaft.
2. Remove countersunk screws (1) holding cover (2) removing cover and gasket.
3. Use puller to remove impeller (4) taking precautions to prevent damage to the casting.
4. Remove seal (5) and water shedder (6).
5. Remove lock ring (13) holding bearing and shaft assembly in body after which shaft (8) can be forced out through the front with an arbor press or lead hammer. DO NOT ATTEMPT TO DRIVE WATER PUMP SHAFT (8) OUT THROUGH REAR OF HOUSING. To do so will damage the housing beyond repair.

REASSEMBLY AND INSTALLATION

1. Reassemble pump, replacing worn or failed parts.

Seal contact surfaces must be smooth and flat. The bushing should be replaced if scored or cut.

A light film of lubricant applied to the face of the seal will facilitate seating and sealing.

2. Use thick soapsuds on both the seal and shaft when assembling in order to prevent damage to the seal.
3. The fan hub must be installed prior to replacing rear plate. The shaft must be supported during this operation to prevent damage to the seal and bushing.
4. Mount pump assembly on block using a new housing gasket.
5. Install fan belt and adjust belt tension to have 3/4" to 1" deflection on long side. (On narrow belts this should not exceed 1/2".) Pull out the alternator by hand, as bearing damage will result with a pry bar; in some cases this may be adjusted by the adjustable fan pulley.

Section 5 - Fuel Systems

The basic purpose of the fuel system is to store, convey, mix fuel with air, then vaporize and introduce the mixture into the engine.

Gasoline is stored in the tank; it is filtered and flows through the fuel supply line to the carburetor — either by gravity or under pressure of fuel pump. The carburetor mixes the fuel with proper proportions of air and at the same time breaks it into very fine spray particles. This atomized spray changes to vapor, by absorbing heat as it travels through the intake manifold to the combustion chamber. Fuel must be vaporized since it will not burn well as a liquid.

GRAVITY FUEL SYSTEM

This is the most simple fuel system and is generally used on power units as it eliminates the need of a fuel pump — it only requires the fuel tank located higher than the carburetor.

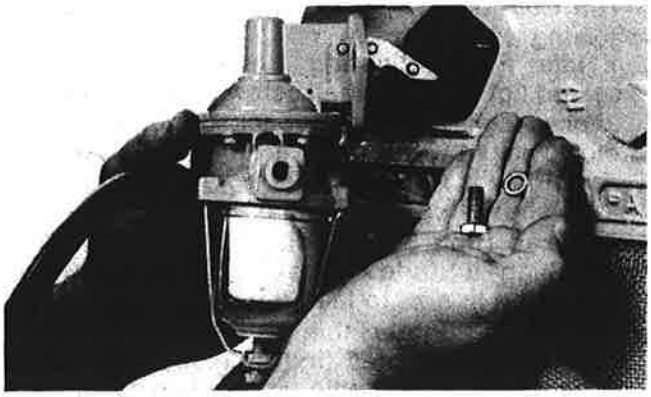
All power units with a fuel tank should have a combination shut-off valve and an efficient metal edge type filter. This filter prevents all foreign particles and water from entering the carburetor.

With reasonable care in filling the tank with clean fuel, this filter will require only seasonal cleaning of both the filter and tank.

CAUTION: It is recommended that the fuel shut-off valve be kept in the closed position except when unit is in operation.

MECHANICAL FUEL PUMP

The Mechanical Fuel Pump is generally used when the fuel supply is below the level of the carburetor.



Fuel Pump

This mechanical fuel pump mounts on the cylinder block pad and is driven by an eccentric on the engine camshaft contacting the fuel pump rocker arm.

Constant fuel pressure is maintained by an air dome and a pulsating diaphragm operated and controlled by linkage which adjusts itself to pressure demands.

Fuel Pump Tests — The fuel pressure may be measured by installing the pressure gauge between the fuel pump and carburetor.

The fuel pump size and static pressures @ 1800 R.P.M. for the L-Head engines are:

ENGINE MODEL	DIAPHRAGM DIAMETER	FUEL PRESSURE	MAX. LIFT
TC, Y, F	3¼	3 - 5 PSI	10'

⚠ WARNING

Smoking or open flame should be avoided any time the fuel system is being repaired or serviced. The area should be properly ventilated. Improper handling of fuel could result in an explosion or fire causing bodily injury to yourself or others.

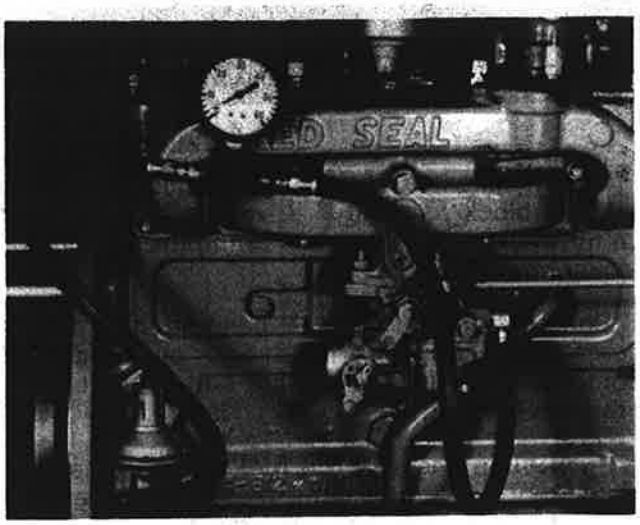
Read and observe safety warnings on pages 1 and 2.

When pressures are below the range, pump should be disassembled and reconditioned with the special overhaul kits available.

Maintenance — Fuel pump trouble is of only two kinds — either the pump is supplying too little gas or, in rare cases, too much.

If the pump is supplying too little gas, the engine either will not run or it will cough and falter. If too much gas — it will not idle smoothly or you will see gasoline dripping from the carburetor.

If the engine is getting too little gas — the trouble may be in the pump, fuel line, plugged filter, or the gas tank. First, be sure there is gas in the tank, then disconnect the pump to carburetor line at the pump or carburetor, and turn the engine over a few times with the ignition off. If gas spurts from the pump or open end of the line — the pump, gas line and tank are OK.



Checking Fuel Pressure

If there is little or no Flow — check the following:

1. Look for leaky bowl gasket or line connections — tighten them.
2. Remove and clean with solvent the gas strainer or screen inside the pump bowl.
3. Look for clogged fuel line — Blow out with compressed air.
4. Make sure that all pump cover screws and external plugs are tight.
5. Inspect flexible fuel line for deterioration, leaks, chafing, kinks or cracks. If none of these items restore proper flow — remove the pump for replacement or overhaul.

If getting too much gas — an oversupply of gasoline is generally caused by trouble other than the fuel pump — so first check the following:

1. Defective Automatic Choke.
2. Excessive use of hand choke.
3. Loosely connected fuel line, or loose carburetor assembly screws.
4. Punctured carburetor float.
5. Defective carburetor needle valve.
6. Improper carburetor adjustment.

If none of these items corrects flooding, remove the fuel pump for replacement or overhaul.

ELECTRIC FUEL PUMP

Many L-Head engines use electric fuel pumps operated from the storage battery supply. The pump should be mounted close to the fuel tank so as to provide fuel pressure at all points along the fuel line and so eliminate vapor lock.

The electric fuel pump is energized in the ignition circuit — which assures quick filling of the carburetor and fuel lines to effect easy starting.

When fuel pump trouble is suspected, disconnect the fuel line at the carburetor and turn on the ignition switch. Pump fuel into a small container, then place your finger on the outlet side of the fuel line. If the pump stops or ticks very infrequently, the pump and fuel line connections are satisfactory. Remove your finger from the outlet side of the fuel line and if ample fuel flows — the pump is satisfactory.

If fuel does not flow and all connections are tight, the pump should be replaced or repaired. Always be sure of a good ground and check for faulty flexible fuel lines and poor electrical connections.

CARBURETOR

Continental L-Head gasoline engines normally use various models of Continental, Zenith (Facet) and Marvel-Schebler Carburetors — of both the updraft and downdraft types.

The carburetor mixes fuel with air and meters the mixture into the engine as the power is demanded. Most carburetors incorporate the following systems to provide the flexibility and sensitive requirements of varying loads and conditions:

1. **Float System** — Controls the level and supply of fuel.
2. **Idle or Low Speed** — Furnishes the proper mixture for the engine idle, light load and slow speeds, until the main metering system functions.
3. **Main Metering System** — Controls the fuel mixture from part throttle operation to wide open throttle.
4. **Power or Economizer Systems (optional)** — Provides a richer mixture for maximum power and high speed operation and a leaner mixture for part throttle operation.
5. **Compensating System** — Provides a mixture which decreases in richness as the air speed increases.
6. **Choke System** — Delivers additional fuel to the manifold for cold engine starting.

CONTINENTAL CARBURETOR

The Continental CK series carburetor has the following adjustments:

1. **Idle Fuel Adjusting Needle** — should be seated lightly with small screw driver, turning in (clockwise). It is then backed out (counterclockwise) 1¼ turns as a preliminary setting. *Fuel* Flow is regulated like a water faucet, turn in to shut off, back out to open.
2. **Fixed High Speed Jet** — is not adjustable. For high altitude it may be exchanged for reduction in size to lean the fuel in compensation for the lighter, thin air. The size must be carefully determined first by testing a smaller jet with .001 to .002 smaller passage depending on the elevation.

2A. **Main Jet Adjusting Needle** — available for use with the fixed high speed jet for altitude compensation. Turn (in) for leaner mixture and (out) for richer mixture.

CAUTION: Improper adjustment of the main jet could lead to engine damage.

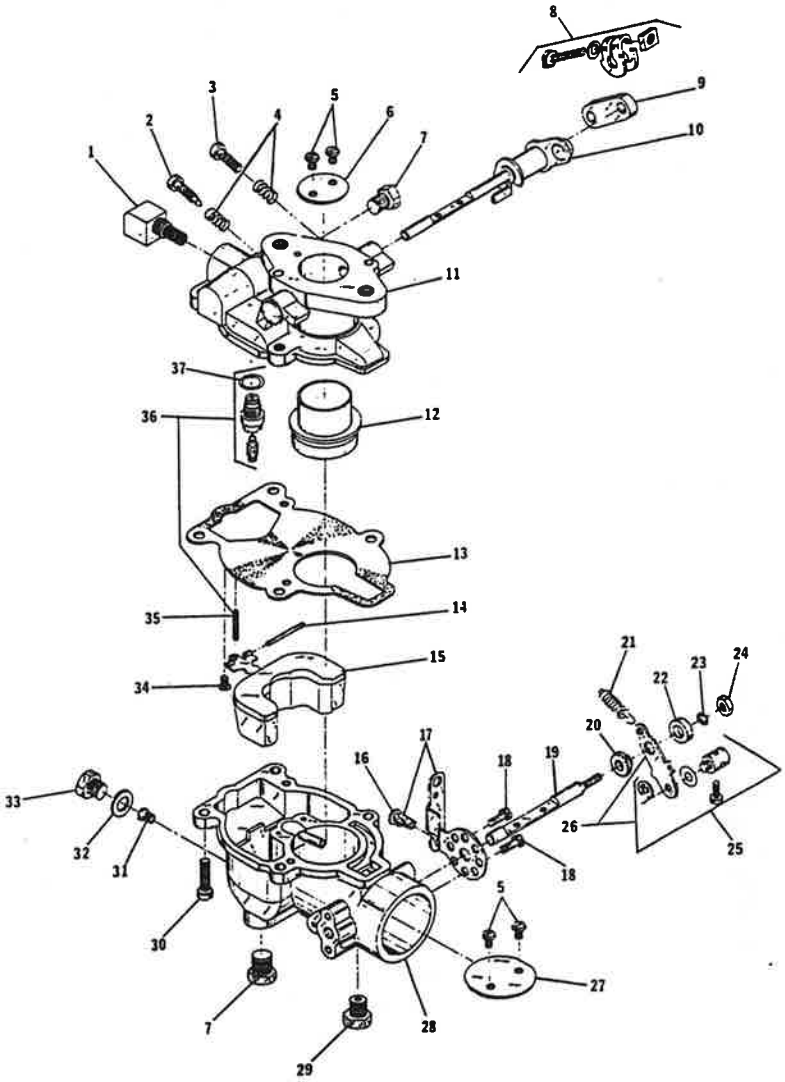
3. **Idle Speed Adjustment Screw** — turn in clockwise until throttle valve is slightly cracked open. Adjustment to recommended idle speed can be made after installation to engine. Turn screw clockwise to increase speed or counter-clockwise to lower the R.P.M.

ZENITH (FACET) CARBURETOR

The Zenith (Facet) 267 series carburetor has the following adjustments:

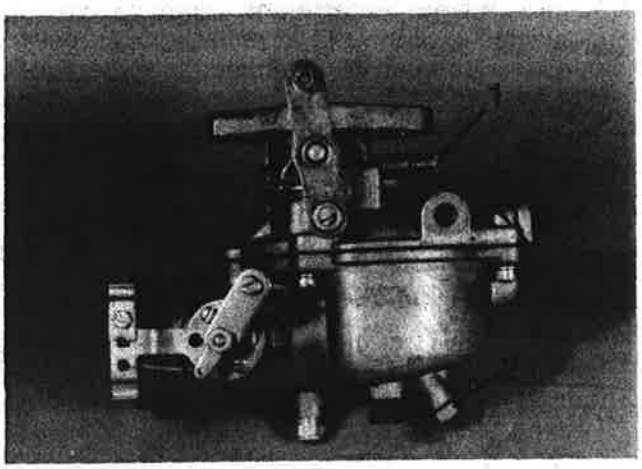
1. **Idle Fuel-Air Adjusting Needle** — The idle fuel-air adjusting needle controls the amount of fuel-air mixture discharged into the air steam. Turning the idle adjusting needle (in) results in a leaner mixture. Turning the idle adjusting needle (out) results in a richer mixture.

2. **Fixed High Speed Jet** — is not adjustable. For high altitude it may be exchanged for reduction in size to lean the fuel in compensation for the lighter, thin air. The size must be carefully determined first by testing a smaller jet with .001 to .002 smaller passage depending on the elevation.



Exploded View - Typical CK Series Continental Carburetor

1 Screen Assembly, fuel inlet
2 Needle, idle
3 Screw, idle speed adjusting
4 Spring, idle needle & screw adjusting
5 Screw, choke & throttle valve
6 Valve, throttle
7 Plug, pipe
8 Clamp Assembly, float lever
9 Lever, throttle floating
10 Shaft Assembly, throttle
11 Body Assembly, includes throttle, shaft & seals
12 Venturi (52)
13 Gasket, body to bowl
14 Pin, float assembly
15 Float Assembly
16 Clip, choke bracket
17 Bracket Assembly, includes Item 16
18 Screw, choke bracket
19 Shaft, choke
20 Bushing, choke lever retainer
21 Spring, choke return
22 Retainer, choke lever
23 Washer, lock, shaft nut
24 Nut, choke shaft
25 Swivel Assembly, choke lever
26 Lever Assembly, choke, includes Item 25
27 Valve, choke
28 Bowl Assembly, fuel
29 Filter, intake drain
30 Screw, fuel bowl to body assembly
31 Jet, main (.046)
32 Gasket, hex head screw
33 Screw, hex head
34 Screw, foat lever pin
35 Spring, buoyancy
36 Kit, includes valves, seat & Items 35 & 37
37 Gasket, valve seat



Zenith Carburetor

2A. **Main Jet Adjusting Needle** — available for use with the fixed high speed jet for altitude compensation. Turn (in) for leaner mixture and (out) for richer mixture.

CAUTION: Improper adjustment of the main jet could lead to engine damage.

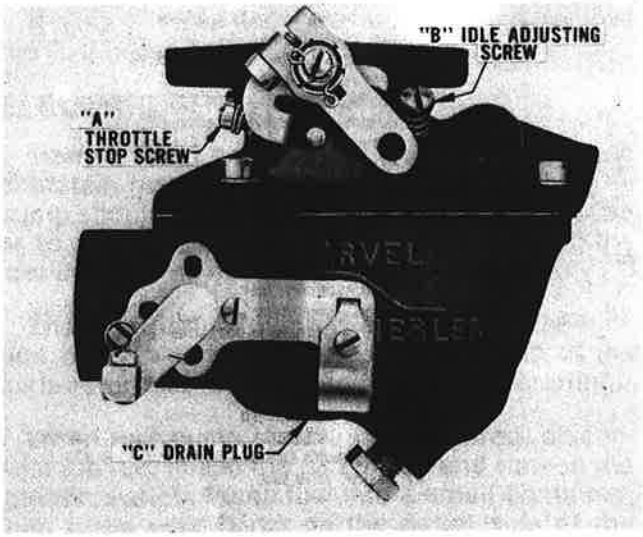
3. **Idle Speed Adjusting Screw** — turn (in) clockwise until throttle valve is slightly open. Adjustment to recommended idle speed can be made after installation to engine. Turn screw clockwise to increase speed or counter-clockwise to lower the R.P.M.

MARVEL-SCHEBLER CARBURETOR
(Model TSX)

The Model TSX carburetor without power adjustment has the following two adjustments.

Preliminary Adjustments

1. Set throttle stop screw "A" so that throttle disc is open slightly.

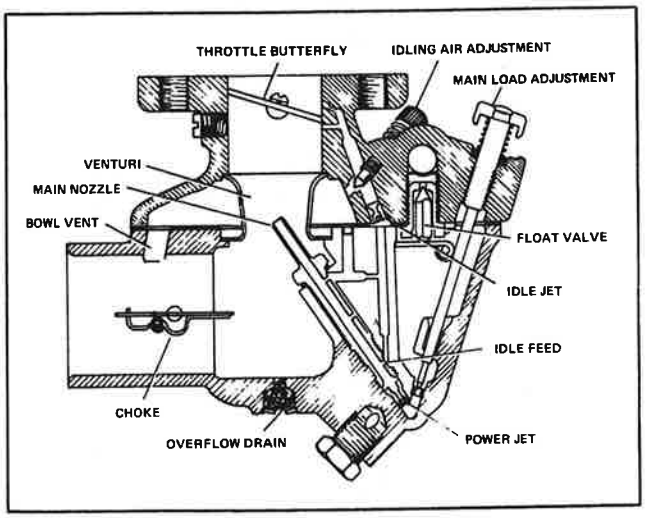


Marvel - Schebler TSX Carburetor

2. Make certain that gasoline supply to carburetor is open.
3. Set throttle control lever to 1/3 open position.
4. Close choke valve by means of choke control button.
5. Start engine and partially release choke.
6. After engine is up to operating temperature throughout, see that choke is returned to wide open position.

Low Speed or Idle Adjustment

1. Set throttle or governor control lever in slow idle position.



Sectional View of the Marvel - Schebler Carburetor

2. Adjust throttle stop screw "A" for correct engine idle speed (normally 400-600 R.P.M.).
3. Turn idle adjusting screw "B" in, or clockwise, until engine begins to falter or roll from richness, then turn screw "B" out, or counter-clockwise, until the engine runs smoothly.

NOTE: IT IS BETTER TO HAVE THIS ADJUSTMENT SLIGHTLY TOO RICH THAN TOO LEAN.

CARBURETOR CHOKES

Manually Operated Choke — is operated by a flexible cable control from the instrument panel or rear house panel. While this is the most simple type, it is most important that the operator have the choke valve in wide open position when engine operating temperature is reached.

Carburetor Service — In general any change in carburetor action will usually come gradually, therefore, if the carburetor operated satisfactorily

when last used, it can reasonably be assumed that some other part of the engine is at fault — which should be corrected before disturbing the carburetor.

Dirt is the main enemy of good carburetion as it fills up the minute air and gasoline passages and accelerates the wear of delicate parts.

Never use a wire to clean out restriction in jets as this will destroy the accurate calibrations of these parts — **always use compressed air.** The jets are made of brass to prevent rust and corrosion and a wire would cut or ream the hole in the jet and ruin it.

Maintaining correct fuel level in the carburetor bowl is important — as the fuel flow through the jets is naturally affected by the amount of fuel in the bowl.

After a carburetor has been in service for some time, the holes in the jet and the float valve and seat become worn from the constant flow of fuel through them and should be overhauled by a competent carburetor service station.

Do not experiment with other size jet or any so-called fuel-saving gadgets as your arrangement has been thoroughly tested on a dynamometer program.

DRAINING FUEL FROM CARBURETOR

Gasoline must be drained from carburetors, following tests on engine or equipment, if it is to be stored for a period of 2 weeks or more, to prevent harmful residue, resulting from fuel vaporization.

⚠ WARNING

Smoking or open flame should be avoided any time the fuel system is being repaired or serviced. The area should be properly ventilated. Improper handling of fuel could result in an explosion or fire causing bodily injury to yourself or others.

Read and observe safety warnings on pages 1 and 2.

Residue formed in the carburetor is very harmful and will result in malfunction of the engine.

All carburetors have a drain plug in the bottom of the carburetor bowl which should be removed and drained dry, Figure 1, "A".

Some carburetor models have 2 drain plugs. Ten minutes should be allowed for draining when removing plug "B" shown in Figure 1.

All engines shipped from the factory have had the fuel drained from carburetor before shipping.

⚠ WARNING

Painting of porous carburetor drain plug can cause fire hazard.

Read and observe safety warnings on pages 1 and 2.

IMPORTANT: On all gasoline engines with updraft carburetors, it is very important not to paint over the powdered bronze carburetor drain plug shown in Figure 2, This has to remain porous to drain off excess gasoline from over choking. If this plug is sealed, gas can back up into the air cleaner hose and create a fire hazard.

If the carburetor is to be painted, coat this porous plug with a thin coat of grease to prevent any sealing action.

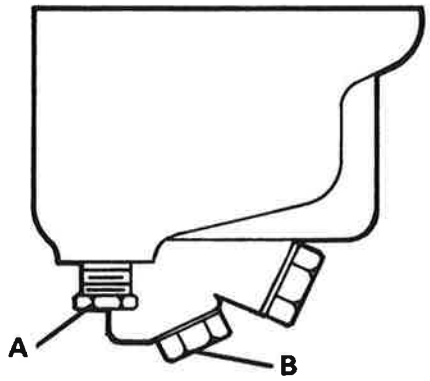


FIGURE 1.

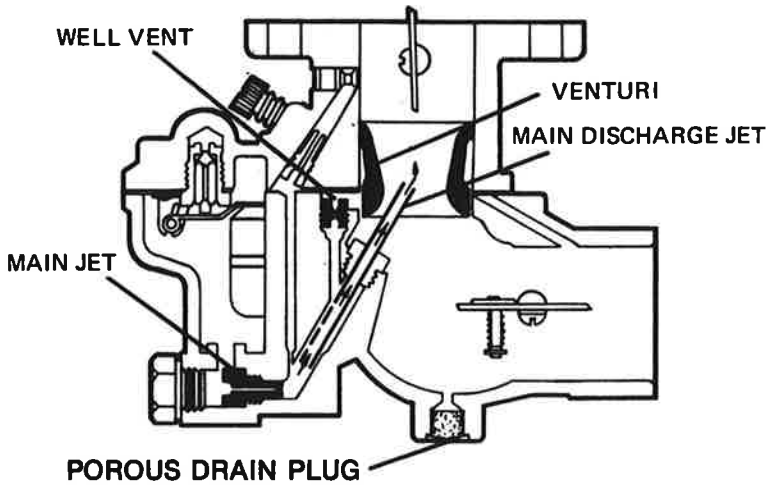


FIGURE 2.

⚠ WARNING

ENGINES USING NATURAL GAS OR LIQUID PETROLEUM GAS (LPG), SEE WARNINGS ON PAGES 1 AND 2.

Consult handbooks and safety instructions provided by manufacturer of end item in which such engine is used or handbooks and safety instructions of the manufacturer of the natural gas or LPG system BEFORE undertaking any work on such system or before any work is begun on the engine or engine sub-systems requiring engine operation.

NOTES

Section 6 - Governors

GOVERNORS

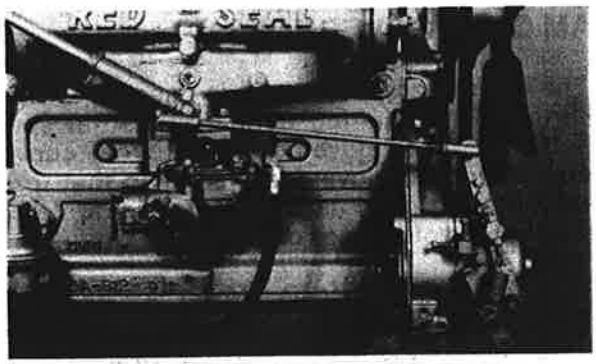
The governor is a device which controls engine speed — either keeping it operating at a constant speed or preventing it from exceeding a predetermined speed.

Continental L-Head engines use many types of velocity and centrifugal governors — however the majority use centrifugal (Mechanical) governors.

CHECKING AND ADJUSTING MECHANICAL - GOVERNOR LINKAGE

The following is a step by step procedure to follow in checking and adjusting the governor linkage:

1. With the engine stopped and spring tension about normal, the governor should hold the throttle in the open position. The governor to carburetor control rod should be adjusted in length so the throttle stop lever is 1/64 to 1/32 off the stop pin.
2. Make certain that all linkage is free with spring at operating tension. Disconnect the governor spring and check movement of levers and rods.
3. The hinged lever governor eliminates the need for a spring loaded throttle lever on the carburetor. As the carburetor lever is forced to idle position by the speed control lever, this in turn pivots the top half of the governor arm forward, slowing the engine to idle.



Mechanical Governor Linkage

CONSTANT SPEED GOVERNOR

⚠ WARNING

Extreme caution must be exercised when making governor adjustments to avoid personal injury due to fan blades, belts and hot manifolds.

Bodily injury or death may result to individuals during operation of an engine within any enclosure not adequately or properly ventilated. Engine operation in any enclosure requires adequate and proper ventilation to avoid asphyxiation or other interruption of normal breathing, to supply sufficient air to cool the engine, provide air to mix with fuel and to carry away heated air from the building.

Read and observe safety warnings on pages 1 and 2.

1. **Start the engine.** Warm up.
2. **With engine warmed up,** adjust idle speed approximately 150 R.P.M. higher than the required speed under load, by turning screw "1" in or out, thus either increasing or decreasing pull on the spring.
3. **Apply the desired load,** and readjust screw "1" in order to obtain the required speed under load.

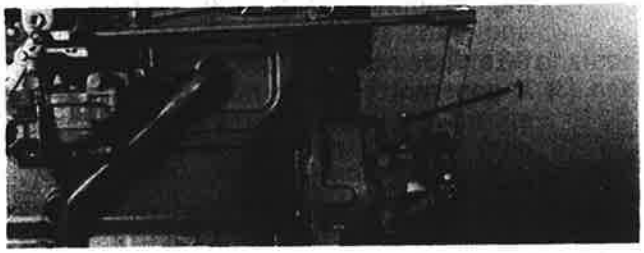
Release load and note R.P.M. at which engine settles out.

Again apply load, and observe the drop in R.P.M. before governor opens throttle to compensate.

4. **The range of a governor's action** is indicated by the differential between R.P.M. **under load** and that **under no load.**

This can be varied and the sensitivity of governor changed by changing the length of screw "2".

5. **To broaden the range of the governor** and produce a more stable action, lengthen screw "2" and compensate for this change by turning screw "1" in to restore speed.



Constant Speed Governor

6. **To narrow the range** and increase the sensitivity of the governor, reverse procedure outlined in 5. (Changing the length of screw "2" has the same effect as using a stronger or weaker spring.)
7. **With the governor adjusted for desired performance,** release the load and allow engine to run at governed speed, no load. If a surge is noted, lengthen screw "2" at spring anchor and readjust screw "1" to obtain desired no load R.P.M.
8. **When governor adjustment is completed,** make sure that all lock nuts are tight, in order to maintain the adjustment.

VARIABLE SPEED GOVERNOR

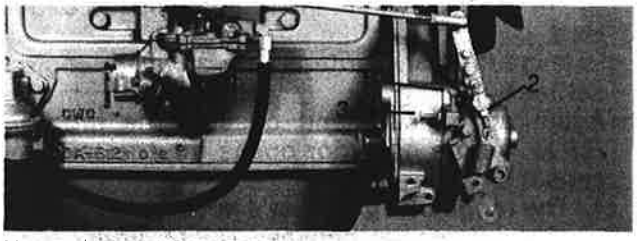
⚠ WARNING

Extreme caution must be exercised when making governor adjustments to avoid personal injury due to fan blades, belts and hot manifolds.

Bodily injury or death may result to individuals during operation of an engine within any enclosure not adequately or properly ventilated. Engine operation in any enclosure requires adequate and proper ventilation to avoid asphyxiation or other interruption of normal breathing, to supply sufficient air to cool the engine, provide air to mix with fuel and to carry away heated air from the building.

Read and observe safety warnings on pages 1 and 2.

1. **Start Engine and Idle** until warmed to operating temperature.
2. **Set Specified High Idle No-Load Speed** by moving throttle to required position and adjusting high speed screw "1".



Variable Speed Governor

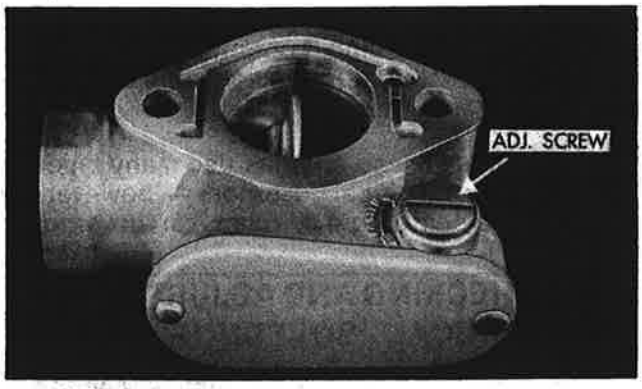
3. **Check Regulation** by applying and removing engine load.
   (1) **If regulation is too broad** increase spring tension with sensitivity screw "2" and readjust high speed screw "1" throttle stop to obtain high idle speed.
   (2) **If regulation is too narrow** decrease spring tension with sensitivity screw "2" and readjust high speed screw "1" throttle stop to obtain desired high idle speed.
   (3) **If governor surges under load** decrease spring tension with sensitivity screw "2" and readjust throttle lever position to desired high idle speed.
   (4) **Stop Screw "3".** Set for low R.P.M. or idle stop.

Repeat above steps as required until desired performance is obtained. When adjustment is complete, lock all lock nuts to maintain settings.

VELOCITY GOVERNORS

Velocity Governors — are generally used to prevent engine speed from exceeding a predetermined maximum. The governor is mounted between the carburetor and manifold flanges. In its most simple form, it consists of a main body, which contains a throttle shaft, a throttle valve and a main governor spring. The main governor spring is attached by linkage to the governor shaft and the spring force holds the throttle valve open.

When the engine is started, air flows through the carburetor throat and the governor throat. The velocity of the air creates a pressure above the throttle valve. When this pressure exceeds the force exerted by the spring, the throttle will move toward a closed position. The adjusting screw varies the spring tension.



Hoof Velocity Governor

When this closing action of the valve exactly balances the spring, governing action takes place and maximum speed is fixed at this point.

When load is applied — the engine speed tends to drop — the velocity of the gas through the manifold and the pressure against the governing valve is reduced and the spring opens the valve to feed more gasoline to the engine to handle the increased load demand. Thus an almost constant speed is maintained whether the engine is running with or without load.

The Hoof Velocity Governor is adjusted by removing the seal wire and with screwdriver turn clockwise to increase speed and counterclockwise to reduce speed.

CAM GEAR GOVERNOR

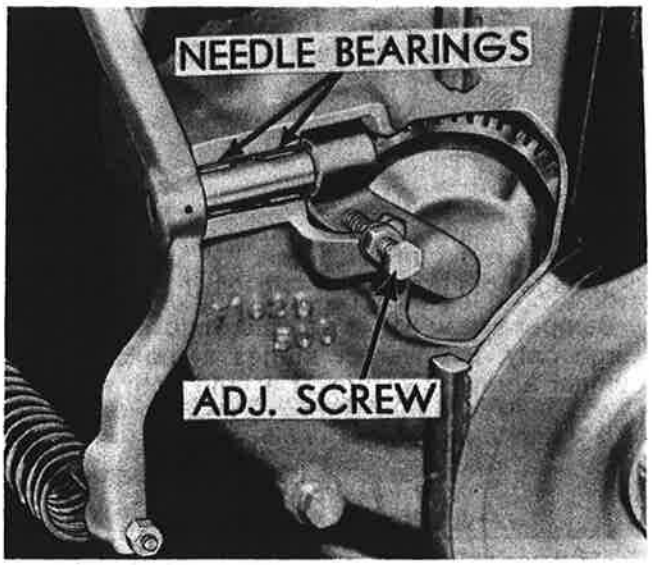
The Cam Gear Governor — is used on most industrial units requiring normal industrial speed regulation. These governors differ from conventional centrifugal governors mainly in that round steel balls are used as the motivating force producer instead of masses of weight.

When the governor is driven at increasing speeds by the engine through the governor gear, the hardened steel balls move outward, forcing the conical upper race, fork base, fork and lever assembly toward a closed throttle position.

An externally mounted spring imposes tension on the lever assembly toward the open throttle position. As the engine speed increases, the centrifugal force created by the balls will increase until a balanced condition between the governor force and the spring force exists and the governing lever remains stationary — holding a constant engine R.P.M.

Adjustment — The desired engine speed is obtained by increasing or decreasing the governor spring tension.

This built-in cam-gear governor is sealed, dust proof, engine lubricated, is compact and easily adjusted. The control shaft floats on two needle bearings to remove friction for closer and more accurate control through the whole power range. This governor is normally used on all industrial applications.



Cam Gear Governor

Control rod movement is determined by accelerator pedal or hand control linkages.

The idle surge adjusting screw should be adjusted "in" just far enough to eliminate any tendency of the engine to surge.

ADJUSTMENTS:

1. **Linkage Adjustment** — With the engine stopped and spring tension about normal, the governor should hold the throttle, (butterfly) in the **wide open position.**

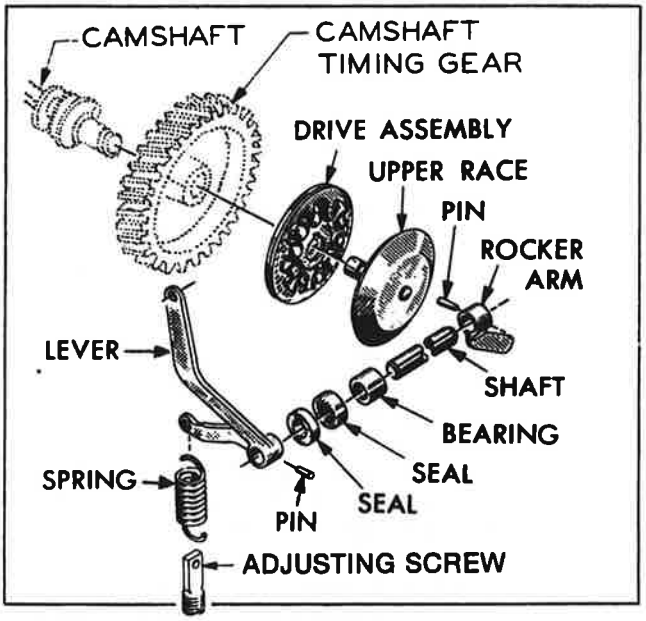
The governor to carburetor control rod should be adjusted in length so that the throttle stop lever is 1/64 - 1/32 off the stop pin. Be sure that the bumper screw is backed out so as not to interfere.

Make certain that all linkage at governor and carburetor operate free — without any binding.

2. **Speed Adjustment** — To increase speed increase spring tension by use of the adjusting screw. To decrease speed decrease spring tension by use of the adjusting screw.
3. **Idle Surge Adjustment** - Turn governor idle surge adjusting screw "IN", or to the right until corrected.

CAUTION: Do not turn bumper screw in far enough to reduce the maximum governed speed for full throttle.

Continued surging — may indicate an excessive looseness or binding of governor linkage and sometimes too lean a fuel mixture.

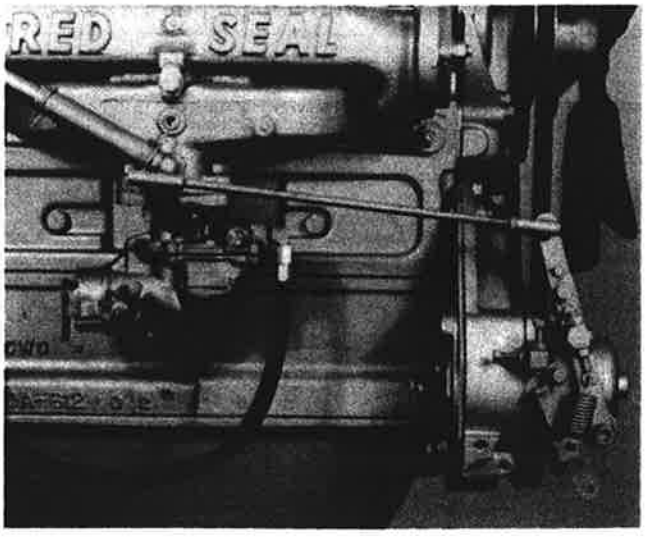


Exploded View of Cam Gear Governor

HINGED LEVER GOVERNOR

The hinged lever governors are basically the same as other Governors, except the governor arm is in two parts. Pivoted on a pivot bolt, it is spring loaded to hold the arm in a straight position except when low idle is desired.

When carburetor lever is forced to idle position by speed control lever, this in turn pivots top half of governor arm forward.



Hinged Lever Governor

On older models, a small coil spring loaded throttle lever and shaft on carburetor was used to get idle position.

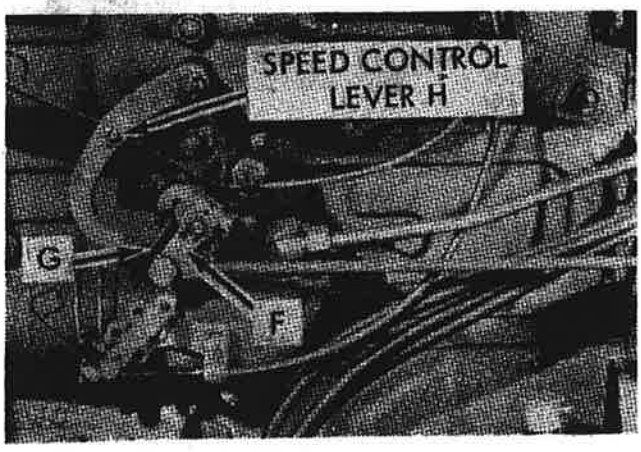
PIERCE GOVERNORS

Pierce Centrifugal Governors are used for many close controlling governor applications, such as generator sets.

Check and adjust the governor linkage in the following steps:

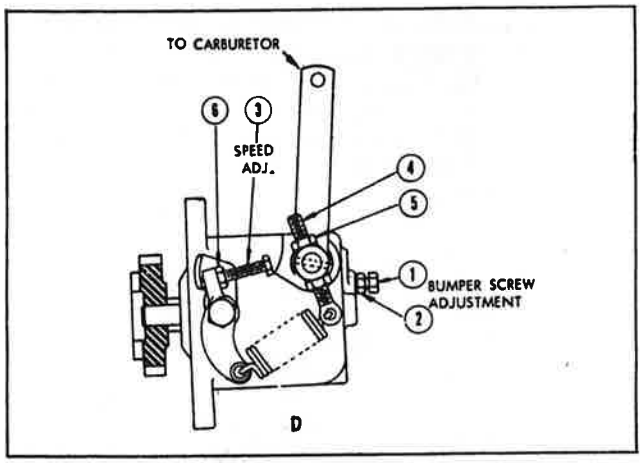
1. **With the engine stopped** — the governor should hold the throttle in the open position. Since it is not necessary for power requirements to have the throttle 100% wide open, the governor to carburetor control rod should be adjusted for length so that the throttle stop lever is 1/64" to 1/32" off the stop pin. This will give you full benefit of the governor action.
2. **Check if all linkage is free** — with spring at operating tension. Then disconnect the governor spring and check movement of levers and rods. Governor control is entirely dependent on the forces of the weights overbalancing those of the spring - so all linkage must move freely.
3. **The Carburetor Lever "F"** — is attached to the throttle shaft by a coil spring, which must have enough tension to move the throttle as a unit with the lever - without any fluctuation due to the air striking the throttle butterfly. This tension may be adjusted by winding or unwinding the spring.

4. **Lever "G"** — which if firmly attached to throttle shaft, serves to slow the engine down, overriding the governor, through the spring loaded lever "F".
5. **Lever "H"** — actuated by a control cable, provides the idle speed control. Moving lever "H" toward the front of the engine moves lever "G" to close the throttle. Check if lever "G" clears "F" by moving lever "G" forward with finger and see if it returns to position freely and quickly.



Then adjust the Pierce Governor as follows:

Constant Speed Type Governor



1. **Back out bumper screw "1"** until only 3-4 threads hold - then lock with lock nut "2".

Bumper screw "1" is used to remove a no-load surge only. If governor surges at no-load, turn bumper screw in a turn at a time until surge is removed. Do not turn bumper screw in far enough to increase no-load speed of engine.

⚠ WARNING

Extreme caution must be exercised when making governor adjustments to avoid personal injury due to fan blades, belts and hot manifolds.

Bodily injury or death may result to individuals during operation of an engine within any enclosure not adequately or properly ventilated. Engine operation in any enclosure requires adequate and proper ventilation to avoid asphyxiation or other interruption of normal breathing, to supply sufficient air to cool the engine, provide air to mix with fuel and to carry away heated air from the building.

Read and observe safety warnings on pages 1 and 2.

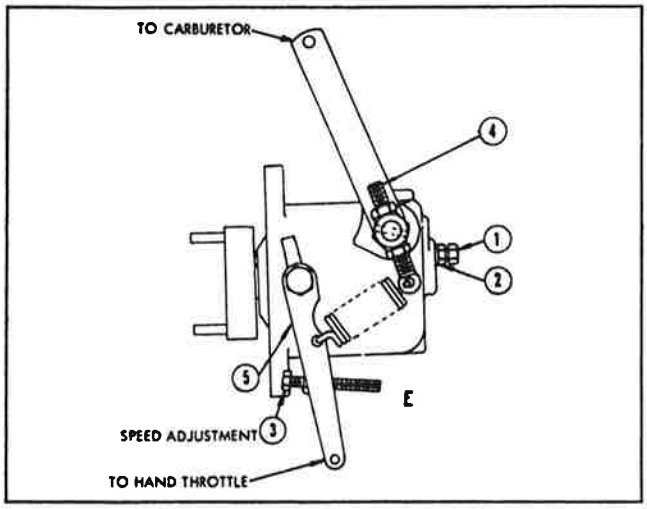
2. **Start engine and idle** until warmed to operating temperature.
3. **Set specified no-load speed** with adjusting screw "3".
4. **Check regulation** by applying and removing engine load. If regulation is too broad, adjust sensitivity screw "4" to move spring nearer throttle lever hub. If governor surges under load, adjust screw "4" to move spring away from throttle lever hub. Lock with lock nut "5".
5. **Re-check speed adjustment** after making regulation adjustment. Lock with lock nut "6".

Variable Speed Type Governor

1. **Back out bumper screw "1"** until only 3-4 threads hold - then lock with lock nut "2".

Bumper screw (1) is used to remove a no-load surge only. If governor surges at no-load, turn

Variable Speed Type Governor



bumper screw in a turn at a time until surge is removed. Do not turn bumper screw in far enough to increase no-load speed of engine. On variable speed and long range variable speed governors, the bumper screw may be used only at the low speed settings.

⚠ WARNING

Extreme caution must be exercised when making governor adjustments to avoid personal injury due to fan blades, belts and hot manifolds.

Bodily injury or death may result to individuals during operation of an engine within any enclosure not adequately or properly ventilated. Engine operation in any enclosure requires adequate and proper ventilation to avoid asphyxiation or other interruption of normal breathing, to supply sufficient air to cool the engine, provide air to mix with fuel and to carry away heated air from the building.

Read and observe safety warnings on pages 1 and 2.

2. **Start engine and idle** until warmed to operating temperature.
3. **Set specified no-load speed** with screw "3".
4. **Move speed change lever "5"** to 3/4 wide open position.
5. **Adjust sensitivity screw "4"** to high idle speed.
6. **Check regulation** by applying and removing engine load. If regulation is too broad, move speed change lever "3" about 1/4" toward closed position and increase spring tension with sensitivity adjustment screw "4". If governor surges under load, decrease spring tension with screw "4" and move speed change lever "3" toward open position to again obtain top no-load speed. Repeat until desired performance is obtained.

NOTES

NOTES

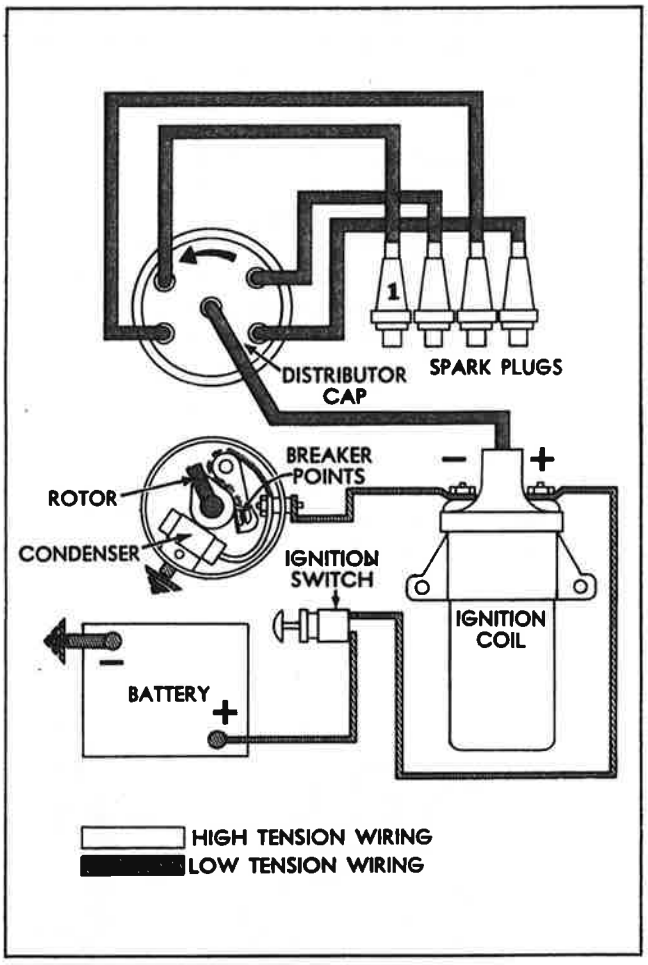
Section 7 - Ignition Systems

Continental L-Head engines are equipped with either an electronic ignition, breaker type ignition or a magneto ignition system.

The ignition system has the job of producing and delivering high voltage surges of about 20,000 volts **to the correct spark plug, at the correct intervals** and with the **correct timing for the engine.** Each high voltage surge produces a spark at the spark plug gap to which it is delivered, so that the mixture of air and fuel in the cylinder is ignited.

BREAKER TYPE IGNITION SYSTEM

This battery-ignition circuit consists of the battery, ammeter, ignition-switch, ignition coil, distributor, spark plugs and low and high tension wiring.



Schematic Drawing of Breaker Type Ignition System (12 Volt)

These parts can be divided into separate circuits consisting of a low tension circuit carrying battery voltage and a high tension spark circuit of about 20,000 volts.

The low tension primary circuit consists of the battery, ammeter, ignition switch, primary winding of the ignition coil, distributor contacts and condenser, and the primary wiring.

The secondary high tension circuit includes the coil secondary winding, distributor cap and rotor, spark plugs, and high tension wiring.

IGNITION SYSTEM COMPONENTS

The **Battery** supplies the voltage for producing a current flow through the ignition circuit.

The **Ammeter** indicates the amount and direction of current flow.

The **Ignition switch** is an "Off" and "On" switch and the **Breaker Contacts** function as an intermittent switch. Current flows only when both switches are closed and returns by the ground through the engine or frame. The resistance of the primary winding of the ignition coil restricts the primary current flow.

The **Ignition Coil** consists of two windings, a primary winding and a secondary winding and is a transformer to increase the voltage high enough to jump a spark gap at a spark plug.

The **Condenser** momentarily provides a place for the current to flow until the distributor contacts are safely separated in order to reduce arcing.

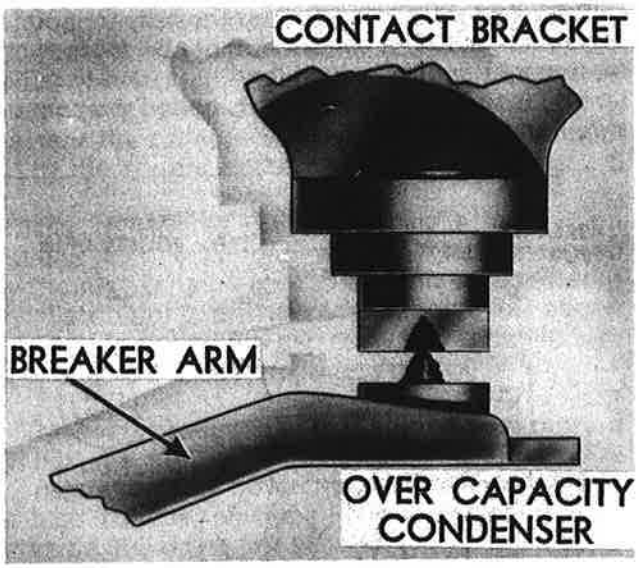
The **Distributor** interrupts the primary winding current in the ignition coil and distributes the high tension current to the correct spark plug at the correct time.

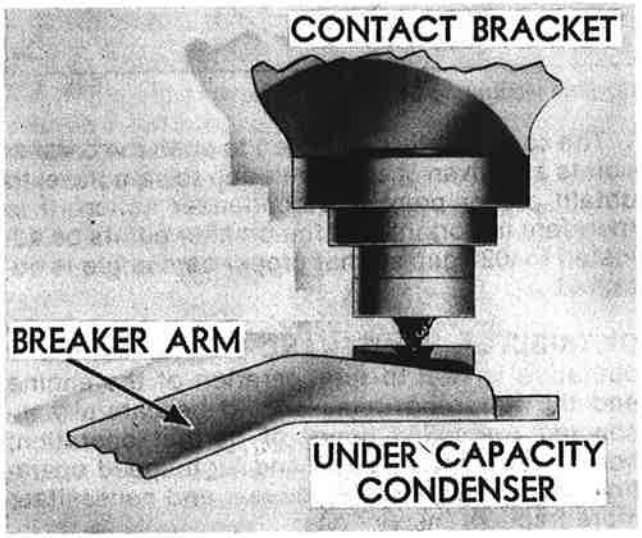
The **Spark Plugs** provide a spark gap in the combustion chamber. The compressed air and fuel mixture is ignited when the high voltage jumps across this gap.

The **Low Tension Primary Wiring** conducts battery current through the ignition coil and contacts.

The **High Tension Secondary Wiring** conducts the high voltage, produced by the ignition coil, to the distributor and from the distributor to the spark plugs.

Operation — A primary current flows from the battery, through the ammeter and ignition switch to the coil primary winding, then to ground through the distributor contacts.





Badly pitted breaker points caused by arcing due to incorrect condensor capacity.

If the points are serviceable, they should be dressed down with a fine-cut stone or point file. The file must be clean and sharp — never use emery coth to clean contact points.

After filing, check the point gap and reset to .020 — the breaker arm must be resting on the high point of the cam during this operation.

When replacing points, make sure they are aligned and that they make full contact. Bend the stationary arm to obtain proper alignment — do not bend the breaker arm.

4. **Lubrication** is required at the shaft, advance mechanism, breaker cam and pivot. The shaft may be either oil or grease cup lubricated and should be given attention every oil change. Make sure the breaker arm moves freely on its hinge and apply a drop of light oil. A trace of ball bearing lubricant such as Mobilgrease Special (with Moly) should be used sparingly on the breaker cam unless lubricated by a felt wick with a few drops of oil.

CAUTION: Avoid excessive Lubrication — as the excess may get on the contact points and cause burning.

ELECTRONIC IGNITION SYSTEM

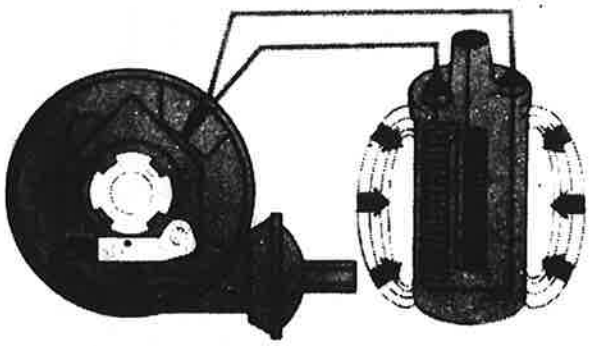
The electronic ignition system maintains a tuned condition longer, since there are no points or condenser. Breaker point erosion and rubbing block wear is eliminated. Wear on the distributor shaft and shaft bearings is greatly reduced. Dwell is permanently controlled by the electronics and total electronic switching offers improved starting. The system is easy to troubleshoot requiring no elaborate test equipment or procedures.

The electronics are fully protected with a moisture resistant material and are designed to resist shock and vibration. Protection against reverse polarity and over voltage is built into the system.

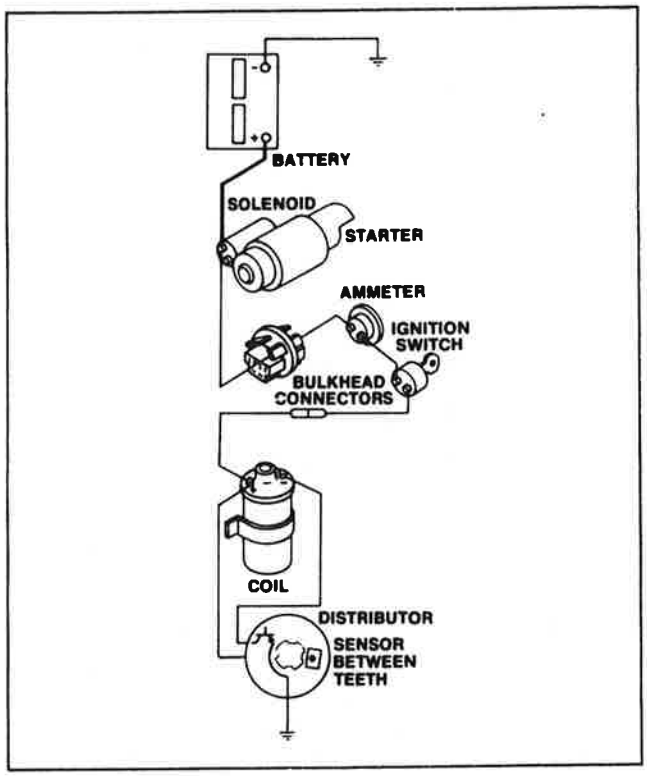
The system will trigger at any speed above zero R.P.M. Each cylinder will fire at the proper time because of close tolerances in the trigger wheel design. Elimination of points and condensers and their inherent problems such as rubbing block wear, plus the longevity of solid state circuitry offers much less downtime and more economical operation.

Integral System

The Integral system houses the electronics inside the distributor. Only two connections are made to the coil.



The primary section is the low voltage section and is composed of the battery, the ignition switch, the ignition coil primary winding, distributor electronics and associated wiring.

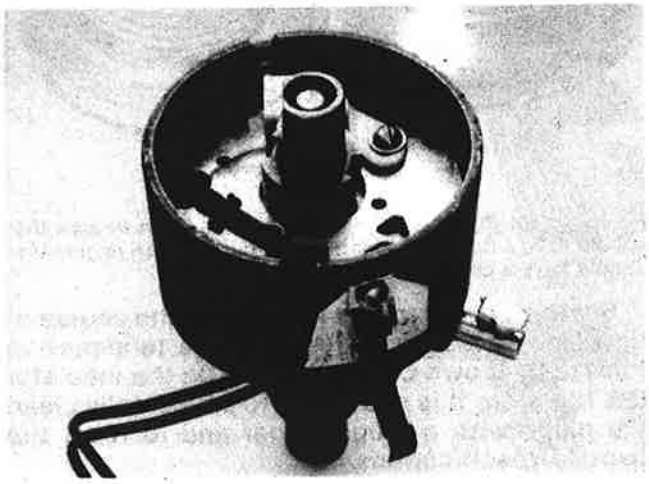


Integral Primary Ignition System

The secondary section is the high voltage section and is composed of the ignition coil secondary winding, the distributor cap, the rotor, the spark plug cables and the spark plugs.

Split System

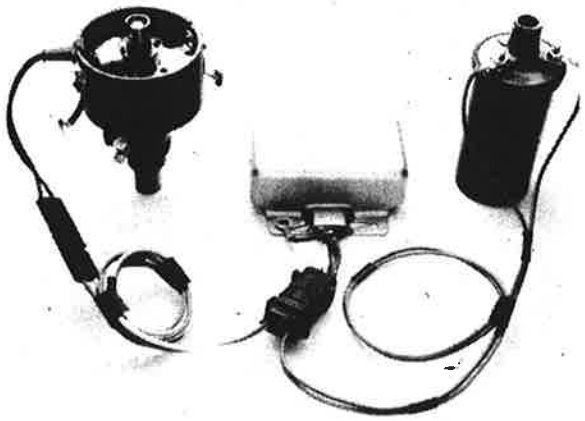
The distributor contains a trigger wheel, sensor, and mechanical advance mechanism.



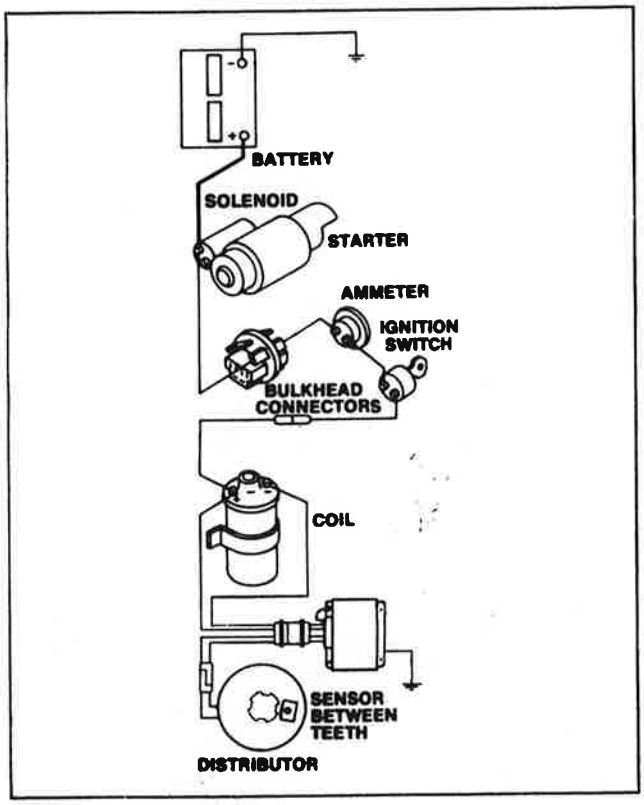
Split System Distributor

The electronic ignition control unit is a solid state, maintenance free unit that contains the electronics necessary to control dwell and primary coil current.

The electronic section of the total ignition system is pictured here. The trigger wheel sensor, control unit, wiring harness and coil primary windings make up the electronic section.



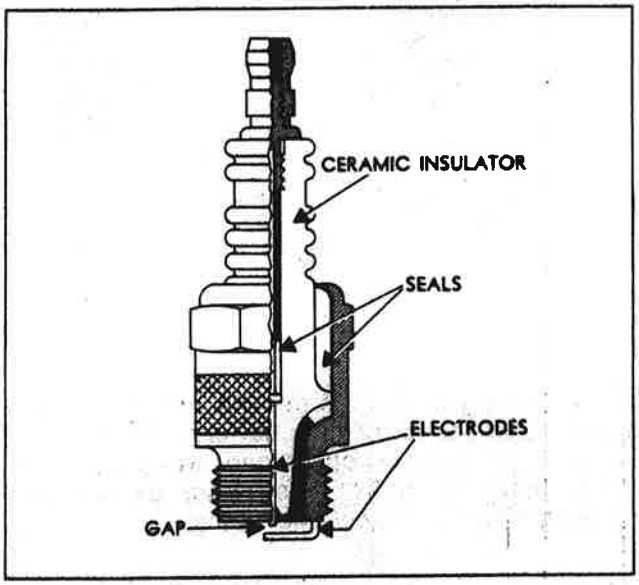
The primary section is the low voltage section and is composed of the battery, the ignition switch, the ignition coil primary windings, electronic ignition control, distributor sensor and harness plus the associated wiring.



Split Primary Ignition System

The secondary section is the high voltage section and is composed of the ignition coil secondary windings, the distributor cap, the rotor, the spark plug cables and the spark plugs.

SPARK PLUGS — A spark plug consists of two electrodes; one grounded to the outer shell of the plug and the other well insulated with a core of porcelain or other heat resistant material. The space between these two electrodes is called the gap which should be set at .025 on standard plugs, for Continental L-Head Engines. Correct and uniformity of the gaps of all spark plugs in the engine is important for smooth running.

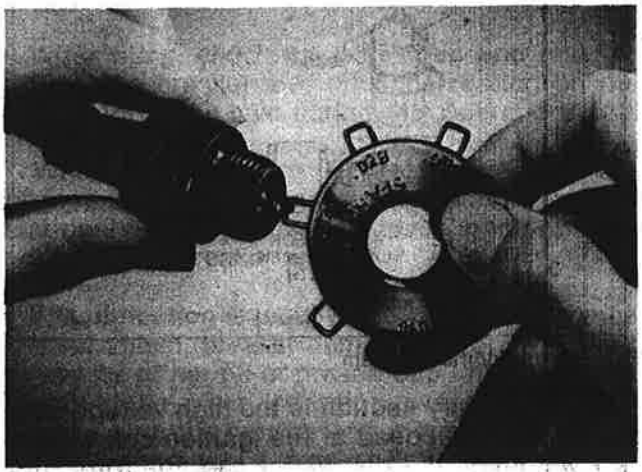


Sectional View of Spark Plug

Spark plug gaps are best checked with a wire gauge unless the points are dressed to obtain a correct reading with a flat gauge. The adjustment should always be made on the side electrode and never on the center electrode which may cause a broken porcelain.

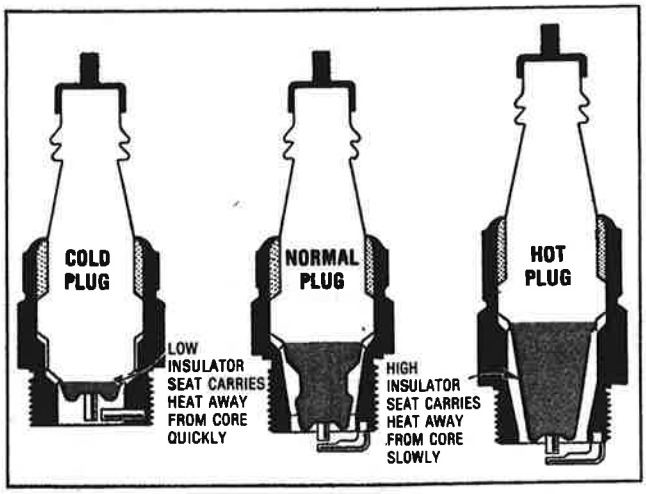
"Gapping" the electrode tip is more easily done with proper tools.

GAPPING THE SPARK PLUG. This illustration shows the use of the gapping tool which both measures and adjusts the electrode gap.



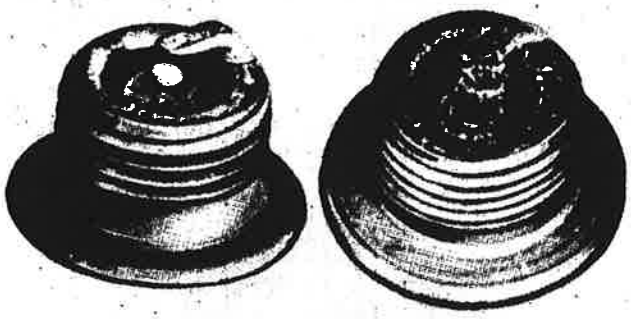
Checking Spark Gap

Spark Plugs must operate within a certain temperature range to give good performance — not too hot and not too cold. The ability of a spark plug to conduct heat away from the center electrode and porcelain is controlled by the design of the shell and insulator — so varying the length of the insulator below the gasket shoulder controls the temperature.



Cold - Normal - Hot Spark Plugs

Examination of a used spark plug will show if it is in the correct heat range for the operating conditions. If the plug runs too hot, the insulator will blister or crack and the electrodes burn away rapidly. If the plug remains too cool — soot and carbon will deposit on the insulator causing fouling and missing.



Faulty Spark Plugs. Left: cold plug used in an engine that should have a hot plug. Right: hot plug used in an engine that should have a cold plug.

Spark plug electrodes will wear in the course of time and present day fuels have a tendency to form rusty-brown oxide deposits on the insulator tip. Therefore it is necessary to periodically clean the plugs with a plug cleaner and to reset the gaps to specifications.

Spark plugs must be correctly installed in order to obtain good performance from them. It is a simple but important matter to follow the following procedure when installing plugs:

1. Clean the spark plug seat in the cylinder head.
2. Use new seat gasket and screw plug in by hand.
3. Tighten all 18mm plugs to 35# torque with socket wrench of correct size.

DISTRIBUTOR IGNITION TIMING
With Timing Light

Normally Continental L-Head engines with distributor-ignition are timed to have the distributor points start to open when #1 cylinder is on compression stroke and the flywheel mark "DC" (top-dead-center) lines up with the pointer in the bell housing.

There are two methods of checking ignition timing — *with or without a timing light.*

The *preferred method* is to use a timing light in the following sequence:

Paint a line on the flywheel (or in some cases, on the front pulley) so the timing mark will be more legible under the timing light.

⚠ WARNING

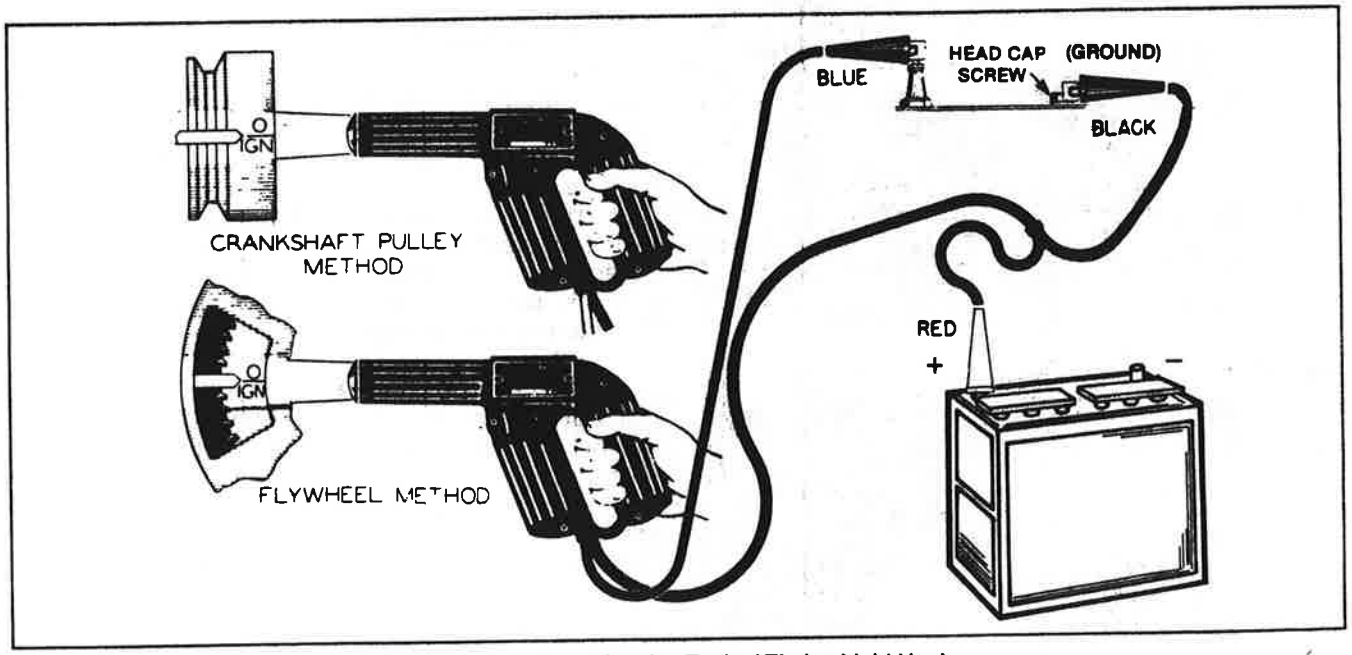
Disconnect fan before timing engine to avoid personal injury.

Do not hold ignition wires with bare hands since shocks or other injuries can result. Sparks or flames near a battery could cause an explosion or fire. Battery acid can cause corrosive burns. Always wear eye protection. Use of jumper cables or battery charging should be done only as directed by manufacturers safety instructions.

Read and observe safety warnings on pages 1 and 2.

1. Clip blue secondary lead of light to the #1 spark plug — leave spark plug wire on plug.
2. Connect primary positive lead (red) to positive terminal of battery.
3. Connect primary negative lead (black) to cylinder head capscrew or alternator bracket.
4. Start engine and run at idle speed, 400 R.P.M. or lower, so the automatic advance of the distributor is completely retarded. THIS IS VERY IMPORTANT TO OBTAIN CORRECT TIMING. On some units it is not possible to idle the engine at 400-500 R.P.M. If this occurs, the engine timing must be adjusted at governed R.P.M. The timing must be obtained from unit manufacturer.
5. Direct timing light on the crankshaft pulley or on the flywheel through opening in bell housing and note timing marks as light flashes.
6. Timing is normally at "DC" unless specified otherwise on your engine specification sheet.
7. To advance timing, turn distributor body clockwise. To retard timing, turn distributor body counter-clockwise.
8. When timing is correct, tighten distributor clamp screw securely. Then re-check timing again with light.
9. This operation is best performed in **shaded area,** so timing light is visible.

Checking Flywheel Timing with Timing Light



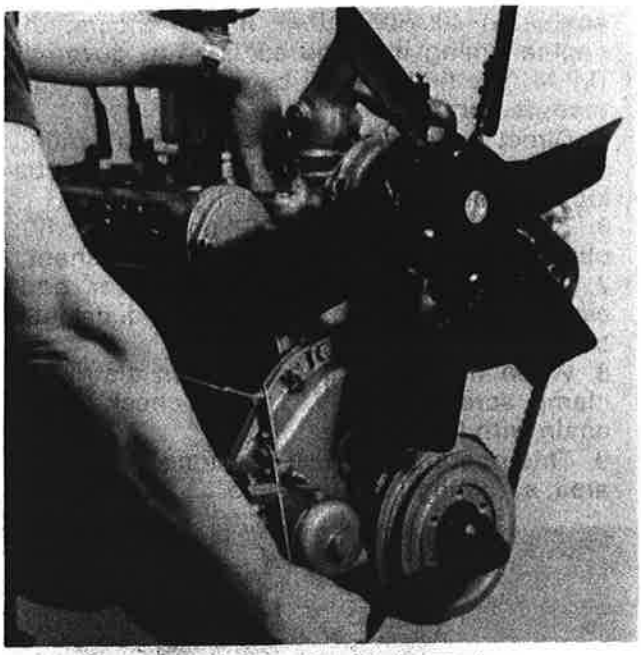
Schematic Diagram Showing Typical Timing Light Hookup

DISTRIBUTOR IGNITION TIMING

Without Timing Light (Emergency Method)

For breaker type ignition an alternative method without timing light is as follows:

1. Remove #1 Spark Plug — put your thumb over the spark plug hole and crank engine by hand until air is exhausting.



Checking No. 1 Cylinder on Compression Stroke

2. Set piston on top-dead-center by slowly cranking until "DC" mark on flywheel (or crankshaft pulley) will line up with the pointer in bell housing (or gear cover).

Note: Some special applications may be timed several degrees before top-dead-center (BTDC).

Flywheel Timing Marks

Crank Pulley Timing Mark

3. Loosen the distributor clamp bolt and rotate the distributor body until the contact points just *Start to open.*

This may be more accurately checked by means of a test lamp connected between the distributor primary lead and the negative terminal of the battery — when the points are closed the light will be ON and as soon as the points break the light will go OFF.

CAUTION: When engine specifications have special timing other than top-dead-center — they must be followed in order to obtain satisfactory service in special applications or higher altitudes.

MAGNETO - IGNITION

Magneto-Ignition is furnished on Continental L-Head engines on special applications to provide a complete ignition system without requiring a battery. The smaller engines are easily hand-cranked so that the starters and generators are not furnished in many of these applications.

The magneto comprises all the parts of the battery-ignition system with the exception of the battery, and in addition, means for generating current impulses directly in the primary winding — which is in effect a spark coil.

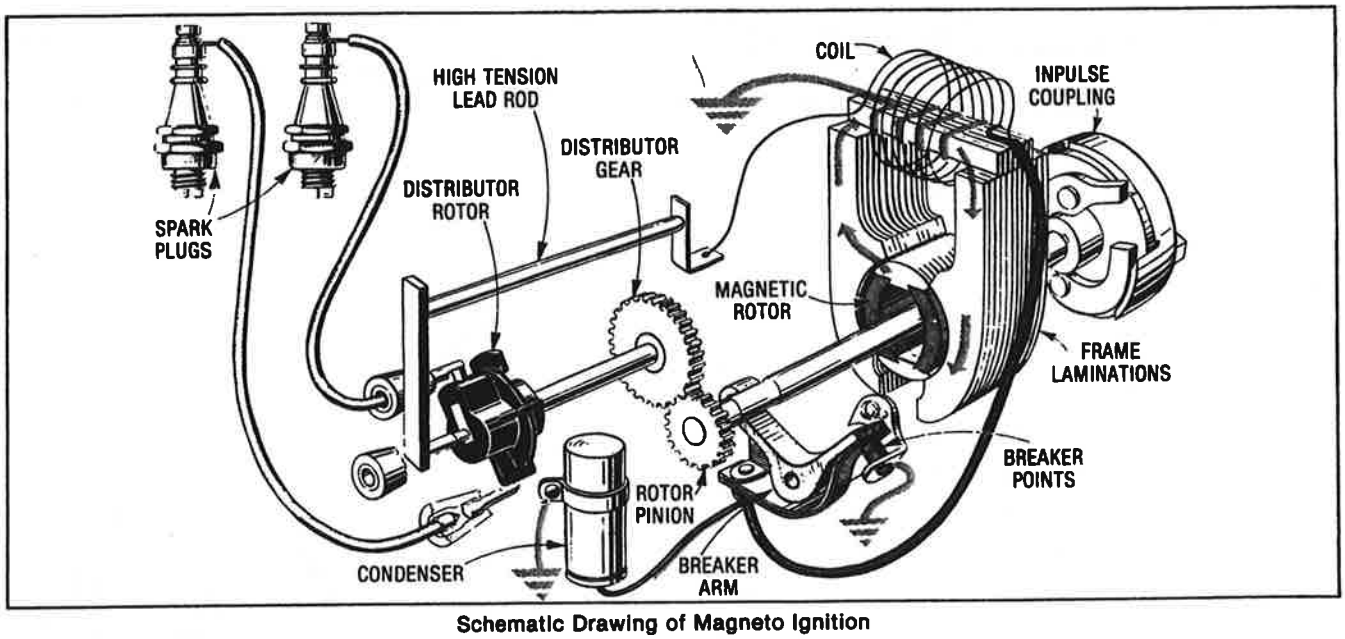
The advantage of the magneto is this self-contained character. All the elements of the ignition system are in one compact unit, from which it only requires a low-tension cable to the ignition switch and high-tension cables to the spark plugs.

Operation

Magnetos are of the rotating magnet type with jump-spark distributor and are flange mounted to an accessory timing gear drive.

The rotation of the magnetic rotor sets up an alternating magnetic flux which cuts the primary winding each time it rises and falls. This induces electric currents, alternating in direction, to flow in the primary circuit during the intervals the breaker points are closed.

The current in the primary winding of the coil establishes a magnetic field which interlocks the turns of the coil secondary winding, this field reaching its maximum simultaneously with the primary current. Breaker point action at the instant of maximum primary current and field, opens the primary circuit so the primary current can't flow — causing the immediate and complete collapse of the magnetic field existing in the coil.



Schematic Drawing of Magneto Ignition

The ratio of turns in the coil secondary winding to those of the primary is very high so the induced voltage in the secondary winding is also very high.

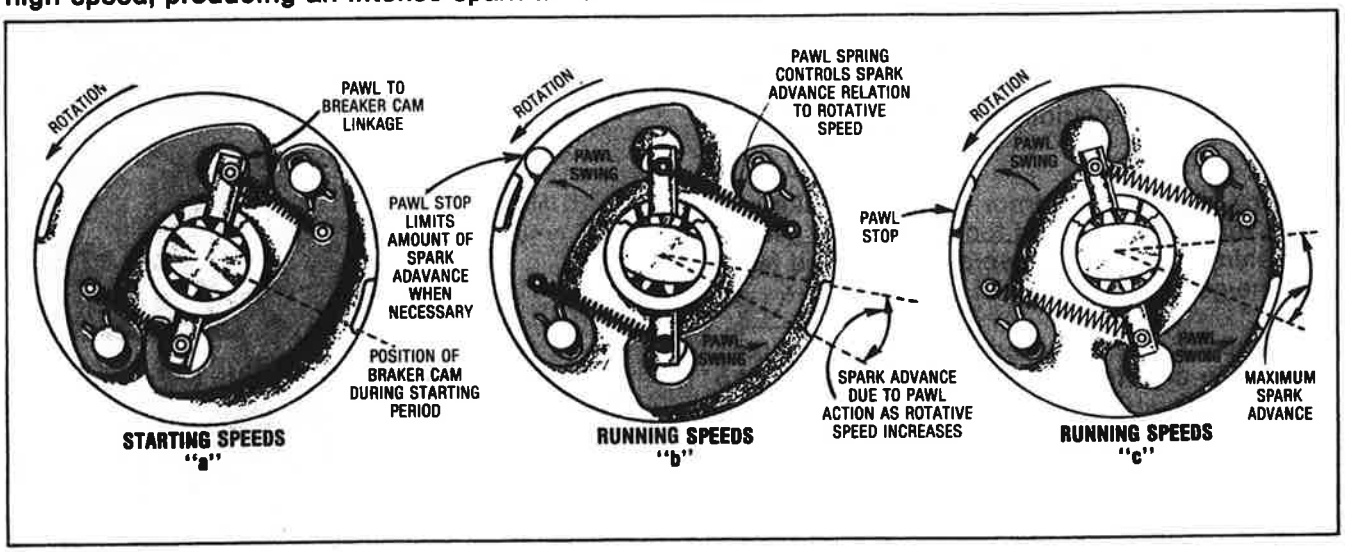
The self-induced voltage occuring in the primary winding, as a result of the quick break of the primary circuit, is absorbed by the condenser which is shunted across the breaker points. This action promotes a more rapid collapse of the primary field and at the same time reduces contact point burning caused by arcing.

IMPULSE COUPLING

All magnetos have an impulse coupling which assists starting by automatically retarding the ignition spark during the starting operation and at the same time producing an intense, hot spark — which would otherwise be impossible at very low engine speeds.

The device prevents the rotor of the magneto from turning during the starting operation until the engine piston is about at top-dead-center, at which instant the rotor is snapped forward at very high speed, producing an intense spark which is automatically retarded to prevent back-firing. Since the point at which the release occurs can be controlled in the coupling construction — it is possible to provide an automatic retard of the ignition spark during the starting period.

Basically the impulse coupling consists of a shell and an hub, connected together by a strong spring. One half of the coupling (shell) is fitted to a drive member on the engine drive shaft — while the other half (hub) is keyed to the magneto rotor shaft.



Operation of Automatic Spark Advance Rotor

AUTOMATIC SPARK ADVANCE

In slow speed operation, a pawl on the magneto half of the coupling engages a stop pin mounted on the magneto frame — which prevents further movement of the rotor. The engine half of the coupling continues to rotate and the relative change in position winds up the connecting spring.

When the desired point of ignition spark is reached, the pawl is released and the drive spring snaps the magneto rotor forward at high speed through its firing position.

TIMING MAGNETO TO ENGINE

As the engine speed increases, the centrifugal force acting on the pawls — withdraws them to a position not engaging the coupling stop pin — the impulse coupling then acts as a solid drive member.

1. Remove rear spark plug (#4 on four cylinder and #6 on six cylinder engines.)

2. Set piston on top-dead-center by slowly cranking until "DC" mark on flywheel (or crankshaft pulley) will line up with the pointer in the flywheel housing (or gear cover)

⚠ WARNING

Magneto wires carry high voltage electrical current capable of giving a shock. If you grasp the molded wire, make sure it is well back of the open end using insulated pliers.

Read and observe safety warnings on pages 1 and 2.

3. With magneto removed from the engine — put it firmly in a vise lined with soft cloths and turn drive lugs of impulse coupling until lead to rear plug (#4 or #6) fires.

   Bosch and Wico magneto indicate #1 lead so rear plug is directly opposite — Fairbanks Morris magnetos are not marked, but rear plug lead is at 5 o'clock position when facing distributor end.

4. Check front end governor drive and make certain that punch-marked tooth of timing gear is meshing between the two punch-marked teeth of the governor drive gear.

5. Turn back magneto drive lugs of impulse coupling counter-clockwise about 1/4 turn so as to mesh with the driving slots of the engine drive member.

6. Position magneto on engine and tighten mounting bolts moderately and connect wires to spark plugs.

7. Start and idle engine 600 R.P.M. and using a timing light connected to rear plug and battery source — check to see if timing is as recommended.

If not rotate magneto assembly until timing is corrected, then tighten magneto bolts.

IMPORTANT: Engine specifications require magnetos with the correct amount of "Built-in Lag" — which permits timing the magneto to the engine correctly as outlined. Do not substitute other magnetos.

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3


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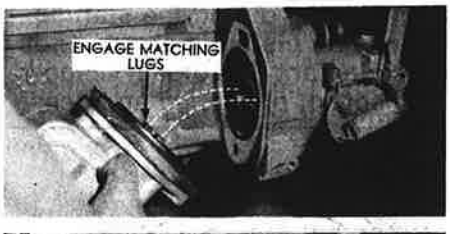

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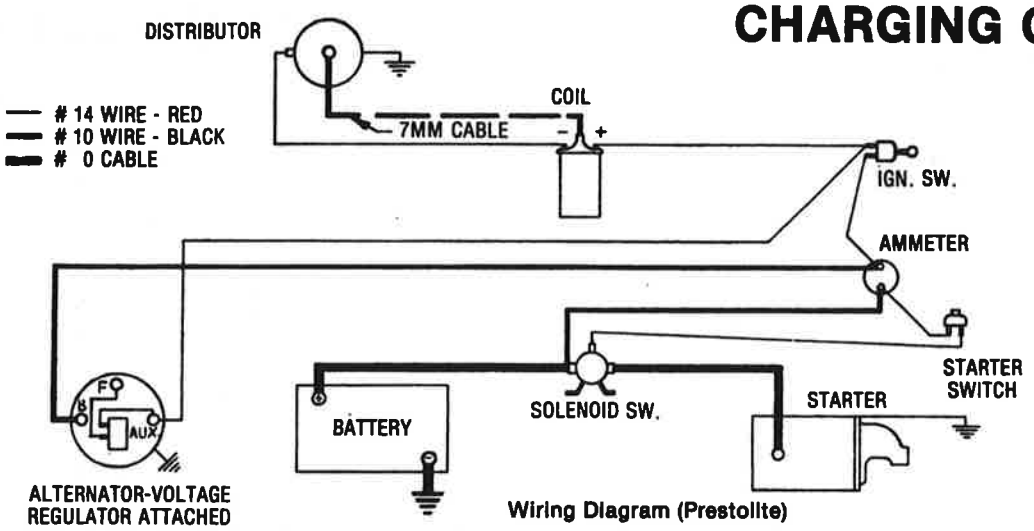
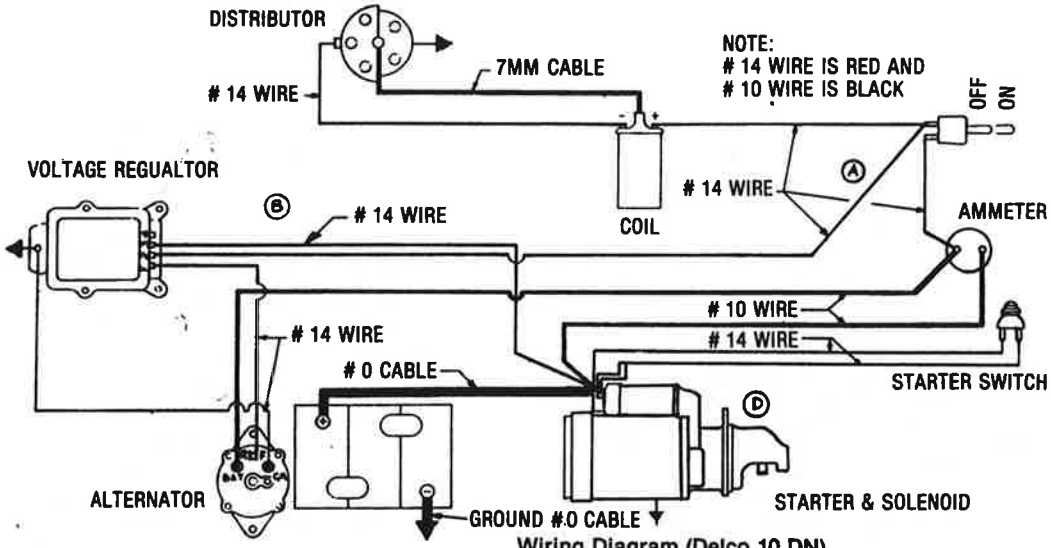
7

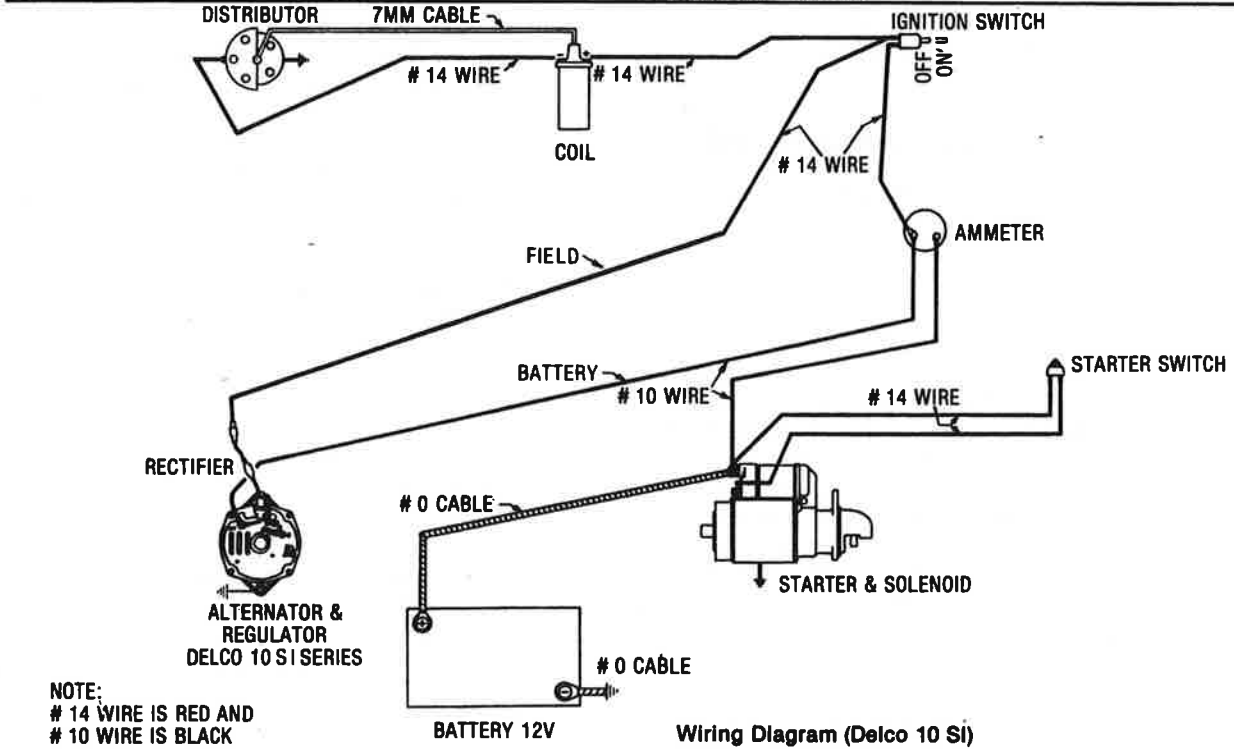

CHARGING CIRCUIT



Wiring Diagram (Prestolite)



Wiring Diagram (Delco 10 DN)



Wiring Diagram (Delco 10 SI)

The charging circuit consists primarily of a alternator, regulator, battery and wiring. When analyzing the charging circuit, the components should be checked in the following order:

I. Wiring

Wiring in the charging circuit should be carefully inspected for frayed insulation or other damage, and replace any wiring that is defective. Also inspect all connections to the alternator, regulator and battery (including all ground connections), and clean and tighten as required.

II. Battery

The lead-acid storage battery, used on automotive and industrial applications, is an electrochemical device for converting chemical energy into electrical energy.

It has three major functions:

1. It provides a source of current for starting the engine.
2. It acts as a stabilizer to the voltage in the electrical system.
3. It can, for a limited time, furnish current when the electrical demands of the unit exceed the output of the generator.

⚠ WARNING

Stop engine before checking battery terminals or electrical connections. Do not hold ignition wires with bare hands since shocks or other injuries can result. Sparks or flames near a battery could cause an explosion or fire. Battery acid can cause corrosive burns. Always wear eye protection. Use of jumper cables or battery charging should be done only as directed by manufacturers safety instructions.

Read and observe safety warnings on pages 1 and 2.

Refer to equipment manufacturer for battery recommendations.

III. Alternator

The alternator differs from the conventional D.C. shunt generator in that the armature is the stationary member and is called the stator: while the field is the rotating member and is called the rotor. Alternating current is rectified (changed to direct current) by means of diode rectifiers rather than mechanically with brushes coming into contact with the various segments of the rotating armature on the generator. With this construction, the higher current values involved in the armature or stator may be conducted to the external circuit through fixed leads and connections rather than through the rotating commutator and brushes as in D.C. generator. The comparatively small values of current supplied to the field may be conducted without difficulty through small brushes and rotating slip rings.

The alternator is somewhat lighter and more compact in design than the conventional D.C. generator of comparable electrical size and is equally as simple to service and test.

Each bearing is prelubricated which eliminates the need for periodic lubrication.

Precautions to be observed when testing or servicing the alternator system:

1. **Disconnect the battery,** before connecting or disconnecting test instruments (except voltmeter) or before removing or replacing any unit or wiring. Accidental grounding or shorting at the regulator, alternator, ammeter or accessories, will cause severe damage to the units and/or wiring.
2. **To avoid damage to the regulator, do not, at any time, connect battery to the regulator field terminal.**
3. **The field circuit must never be grounded, on this system, between the alternator and the regulator.** Grounding of the field terminal either at the alternator or regulator will damage the regulator.
4. **If it is necessary to solder any lead to a rectifier lead,** use a pair of pliers as a heat dam between the solder joint and the rectifier.
5. **The alternator must not be operated on open circuit with the rotor winding energized.**
6. **Do not attempt to polarize the alternator.** No polarization is required. Any attempt to do so may result in damage to the alternator, regulator, or circuits.
7. **Grounding of the alternator output terminal may damage the alternator and/or circuit and components.**
8. **Reversed battery connections may damage the rectifiers, wiring or other components of the charging system.** Battery polarity should be checked with a voltmeter before connecting the battery.
9. **If a booster battery or fast charger is used, its polarity must be connected correctly to prevent damage to the electrical system components. (positive to positive, negative to negative.)**

IV. Regulator

Some regulators are fully transistorized and completely sealed. These can not be adjusted or repaired, and it can be assumed that this type regulator will outlive the other components in the charging system.

Other regulators are adjusted and repaired

in accordance with the manufacturer's instructions.

Installation of Regulator for Alternator

To insure proper operation and to protect the alternator and regulator, the following steps should be observed during installation.

1. Make sure regulator is of the same voltage and polarity as the alternator and battery.
2. Disconnect battery cable at battery terminal.
3. Make sure the mounting area of the alternator and regulator base are clean and make a good tight connection.
4. Connect alternator in accordance with the manufacturer's instructions.
5. Do not flash field or ground terminals of the regulator.
6. Reconnect battery cable.
7. Start engine and observe ammeter. A "High" charge rate is normal for the first few minutes, but will decrease as the regulator warms up.

Note: When servicing the charging system, never remove a unit until tests have shown it to be defective. Reference always should be made to the manufacturer's maintenance manuals for complete trouble shooting instructions.

NOTES

Section 8 - Preventive Maintenance

In order to obtain maximum efficiency from your gasoline engine, a definite maintenance program should be set-up and followed. Haphazard maintenance will only lead to faulty engine performance and shorten engine life.

All moving parts in the engine are subject to wear; however, wear **can be retarded** by careful operation and a planned maintenance program.

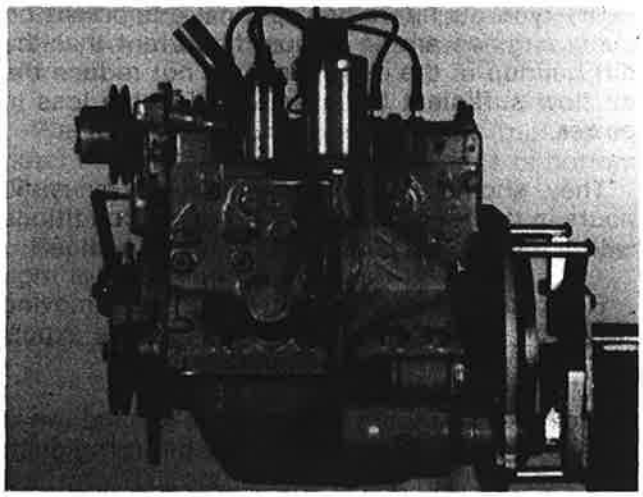
In general, gasoline engine operation demands careful attention to the cleanliness of **air, fuel** and **oil** and maintaining coolant operating temperatures of 180°-200° F.

The following pages, covering **Daily, 50-250** and **500** hour maintenance, have been worked out with our field service division as "Minimum Requirements" to keep your engine in dependable operating condition.

DAILY PREVENTIVE MAINTENANCE SCHEDULE

1. OVERALL VISUAL INSPECTION OF ENGINE

Look for evidence of fluid leaks on floor, cylinder head and block, indicating loose fuel, oil or water connections — **tighten if found.**



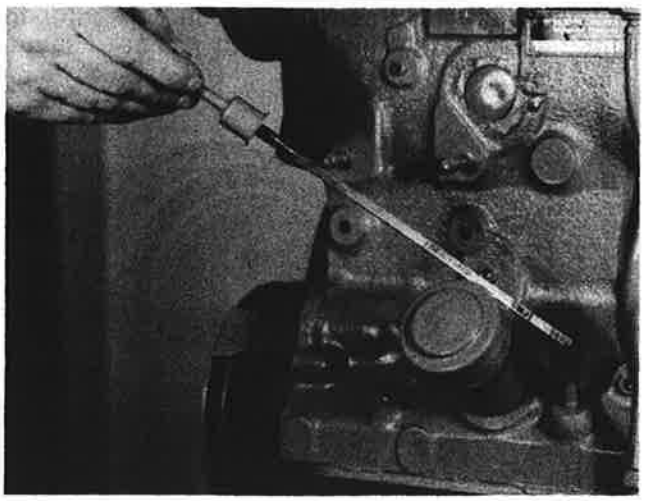
Check for Possible Leakage

2. CHECK OIL LEVEL OF ENGINE

The dipstick indicates the high and low oil level in the crankcase—make allowance for additional oil drainage back into oil pan if engine has not been stopped 15 minutes. The most efficient oil level is between the two dipstick levels.

IMPORTANT: Do not add oil until oil level approaches the low mark — then add only enough to bring it to high level — NEVER above.

Do not operate the engine with oil below low level mark.



Check Oil Level of Engine

3. CHECK RADIATOR

Fill radiator with clean water or anti-freeze to normal level maintained due to expansion when heated. Visually inspect fan and belt for condition and adjustment.

4. FILL FUEL TANK

Should be done at end of day's operation to prevent condensation forming in tank. Clean filler cap and area around spout before filling to prevent entrance of dust into fuel system.

5. CHECK AIR CLEANER

All engines, when operating, consume several thousand cubic feet of air per hour. Since dusty air is full of abrasive matter, the engine will soon **wear excessively** if the air cleaner does not remove the dust before entering the cylinders.

On any air cleaner, operating environment dictates the air cleaner service periods. In extremely dusty operations this may be once or twice daily. In dust protected areas the air cleaner should be serviced when changing oil.

Two basic types of air cleaners are normally used — the oil bath type and the dry replaceable element type.

OIL BATH AIR CLEANER

The oil bath air cleaner must be given close and frequent attention. The efficiency of an oil bath cleaner is very closely linked to the amount and viscosity of the oil used. As dirt is strained from the air flowing through the cleaner, it thickens the oil in the cup and also raises the oil level in the cup. The proper method of servicing an oil bath air cleaner begins with pouring the old oil from the cup. Wipe the cup with a clean cloth. Refill the cup to the mark, being careful not to exceed this line. It is generally recommended to use SAE-20 oil in the summer and SAE-10 oil or lighter in winter.

Fill Oil Bath Air Cleaner Cup to the Indicated Mark.

1. SERVICING REMOVABLE PRE-FILTER

Some oil bath air cleaners have removable pre-filters - which stop all lint, chaff and fibrous material that enter.

Remove the pre-filter every time the air cleaner is serviced, and wash out all chaff or dust in a solvent.

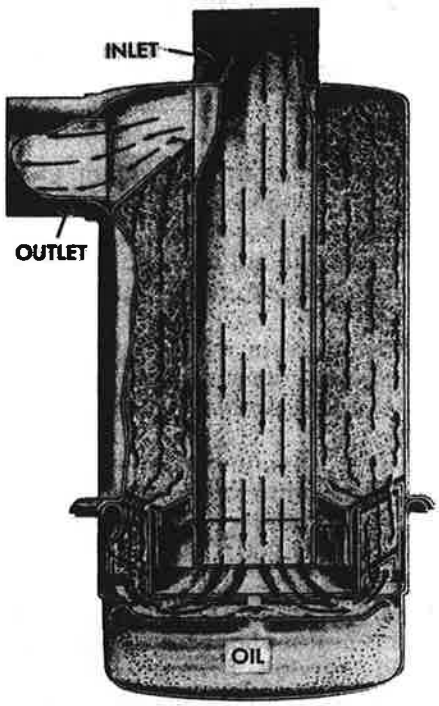
2. SERVICING MAIN FILTER ELEMENT

This filter element is made up of thousands of steel springs, interlocked and compressed to a mass of uniform density - which traps the oil and completes the cleaning process.

Normal service - completely remove the air cleaner every **4-6 months** - remove the bottom half and pre-filter then immerse and back flush the main filter element with a cleaning solvent.*

Severe service - will require cleaning of this element **every week** or more frequently if required.

*Be sure element is dry of all cleaning solvent before reassembling.



Sectional View of Oil Bath Cleaner

CAUTION: Do not steam-clean or use high pressure air to clean the filter element as it opens a direct channel through the filter - which permits oil, as well as dirt, to pass directly through the oil bath cleaner.

DRY TYPE REPLACEABLE AIR FILTER

Dry type air filters are optional equipment on many engines and it is most important that the dirt buildup in the cartridge does not reduce the air flow sufficient to cause a noticeable loss in power.

They should normally be serviced every 50 hours in the following steps: (Extreme conditions will require daily cleaning.)

Remove cartridge and cover after removing wing bolt - do not allow dirt to fall into the exposed carburetor on gasoline engines.

Clean cartridge by gently tapping flat on a smooth horizontal surface to shake out the dust.

⚠ WARNING

Wear protective glasses or a face protector whenever air hoses are used. Never use air pressure that is more than 30 pounds per square inch (psi) 205 kilo Pascal (kPa) and make sure the air line is equipped with a water filter to prevent damage to parts.

Read and observe safety warnings on pages 1 and 2.

Cartridge can be cleaned best by blowing compressed air from inside out. Do not apply air closer than two inches and don't use more than 30 pounds pressure.

CAUTION: Do not damage gasket surfaces or bend outer screen.

Wipe inside screen, cartridge gasket surface, inside cover and mounting seat before installing element.

Place cartridge on mounting seat - make sure outer edge of cartridge fits inside edge of bottom plate.

Replace cover and assemble wing bolt finger tight to insure air filter seal.

CAUTION: Do not wash or oil cartridge.

Replacing New Cartridge.

Replace immediately if bent, crushed or damaged. Dry type air cleaners are efficient only as long as top and bottom sealing edges are not damaged.

Also surface of air cleaner base and cover where air cleaner cartridge seals, must be clean and not damaged, such as dents or bends.

Often in cleaning cartridge it is tapped against surfaces that are not flat, thus damaging sealing edge. Regardless of how clean paper is, **if edges are damaged dirt will enter the engine.**

Element should be replaced every 250 hours or when servicing does not result in full power recovery - whichever occurs first.

Under extreme dust conditions more frequent replacement will be required. Replace when power loss remains after servicing or when the intake manifold vacuum exceeds 10" water, using a good water manometer (mechanical vacuum gauges read in mercury and 1" is equivalent to 13.6" of water).

A ¼ Teaspoon of Dust per Hour Can ruin an Engine in One 8 Hour Day

PCV SYSTEM

All connections must be air tight.

Blow-by, within reasonable limits, circulates thru the fixed orifice into the intake manifold maintaining crankcase pressure within a narrow range regardless of operating speed or load.

The dump tube to the air cleaner serves to handle excessive blow-by as the engine becomes badly worn. At that point the engine is usually in need of an overhaul.

Servicing of the PCV system is usually confined to cleaning the PCV orifice and/or valve along with cleaning the air inlet, where applicable.

CHECK OIL PRESSURE*

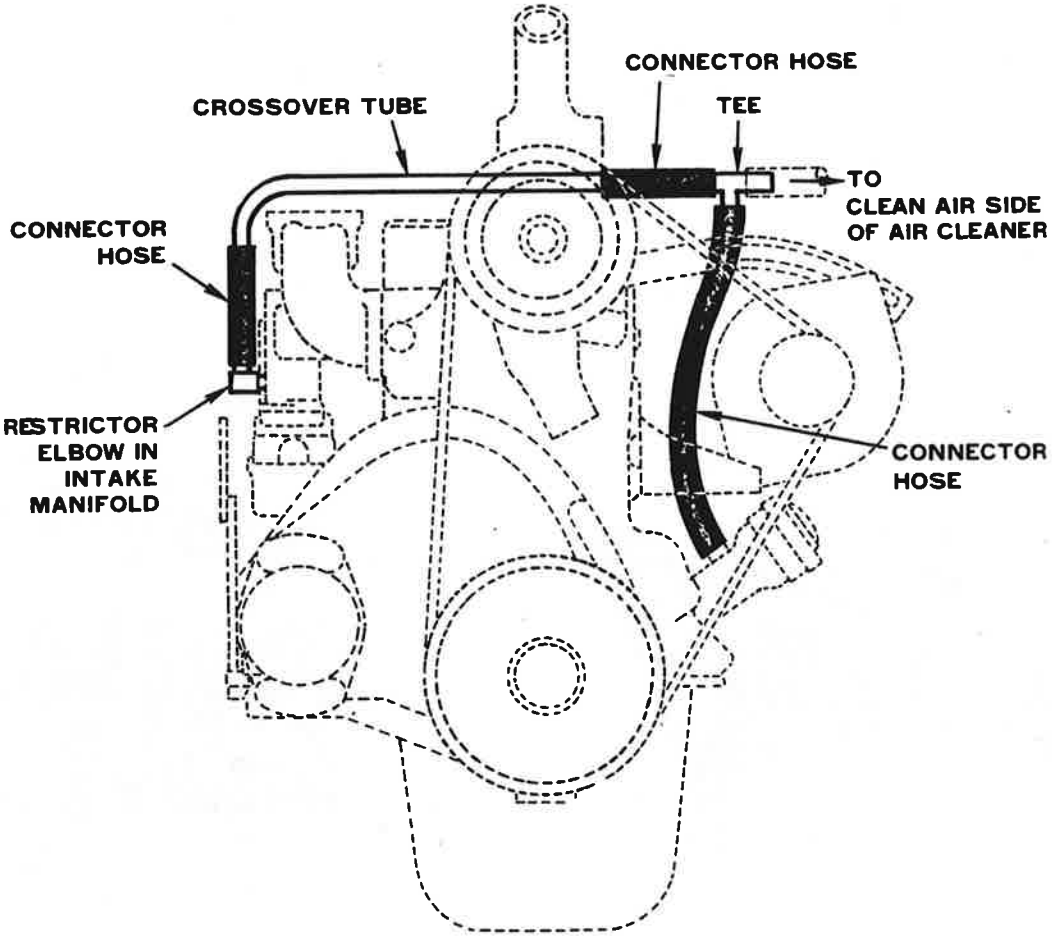
Note oil pressure gauge which should indicate the following pressure range at full throttle and a minimum of 7 pounds pressure at idling speed.

MODEL	OIL PRESSURE
TC-Y-F Series (with standard oil pressure relief spring)	30-40#

*Standard Engines: on some special customer specifications, this may change.

NOTE ANY UNUSUAL NOISE

Operators familiar with daily engine operation soon become alert to any noise not normally present. This is very valuable in correcting defects in the early stages and preventing expensive repairs or delays.



Typical Continental Motors PCV System Installation

Do not put kerosene into the crankcase. The best method is to drain the oil when the engine is thoroughly heated — which will carry off most of the sediment.

EVERY 50 HOURS

1. REPEAT DAILY OPERATIONS OUTLINED

Follow previous instructions.

2. CHANGE CRANKCASE OIL

Engine life is dependent upon clean oil being circulated to all moving parts; therefore, the frequency of oil changes and oil filter replacement is very important and should be made at regular, scheduled periods.

The schedule for changing oil is directly dependent upon the operational environment: an extremely clean operation could go 150 hours while a dirty operation (foundry or cement factory) could be 50 hours **or less.**

Replace the oil filter element every 150 hours unless extremely unfavorable operating conditions indicate that filter replacements should be made at every oil change period.

Thoroughly clean the filter, cover and sealing surfaces before replacing new element and gasket.

DO NOT FLUSH CRANKCASE WITH KEROSENE

Some operators unwisely put kerosene in the crankcase after draining the engine oil, then turn the engine over with the starter—in the belief they are doing a better job of crankcase cleaning.

In doing this, kerosene is circulated through the oil pump, the main oil header and the branches leading into the engine bearings—thereby washing away the protective oil film. In addition, some of the kerosene will be trapped and remain to thin out the new oil, reducing its lubricating qualities.

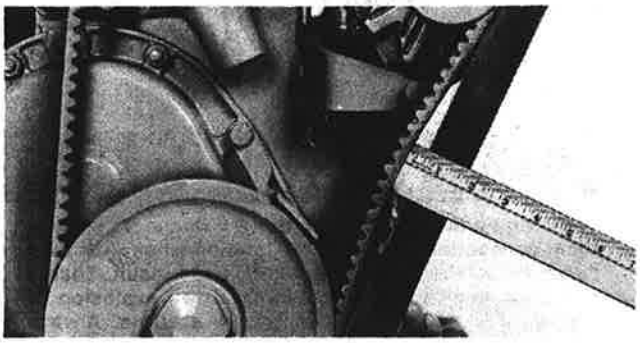
3. SERVICE AIR CLEANER

If oil-bath air cleaner is used, remove bottom half of air cleaner—clean thoroughly and fill with engine oil to oil level mark on cup, avoid overfilling. Replace cup and check all connections to manifold. Be sure that no unfiltered air can enter the engine intake manifold.

If a dry type air cleaner is used, clean element with compressed air. **(See Daily Instructions)**

4. CHECK FAN BELT TENSION

Inspect wear condition of fan belt; note alignment and check belt tension which should allow not over 1/2" deflection on long span on narrow belts and 3/4" to 1" deflection on wide belts.



Fan Belt Tension

5. CHECK BATTERY

⚠ WARNING

Stop engine before checking battery terminals or electrical connections. Do not hold ignition wires with bare hands since shocks or other injuries can result. Sparks or flames near a battery could cause an explosion or fire. Battery acid can cause corrosive burns. Always wear eye protection. Use of jumper cables or battery charging should be done only as directed by manufacturers safety instructions.

Read and observe safety warnings on pages 1 and 2.

Check specific gravity of each cell — which should be at least 1.250. Add distilled water, if required, to raise level 3/8" above the separators.

Checking Battery

Particular attention should be given battery during cold weather. The cranking power of a fully charged battery @ 80° F. is reduced 60% @ 0° F. — yet the power required to crank the engine is 2 1/2 times greater at 0° F. than @ 80° F.

6. LUBRICATE GENERATOR AND STARTER

Apply 3-5 drops of engine oil to each cup on the generator and if required on the starter (Many starters and most alternators have sealed bearings).

Generator Lubrication

Starter Lubrication

7. TORQUE DOWN CYLINDER HEAD TO SPECIFICATIONS IN MANUAL.

8. ADUST IDLE MIXTURE AND IDLE SPEED TO 400-600 R.P.M. For the Y and F series engines and 800 R.P.M. for the TC56 engine. Repeat again at end of 500 hours.

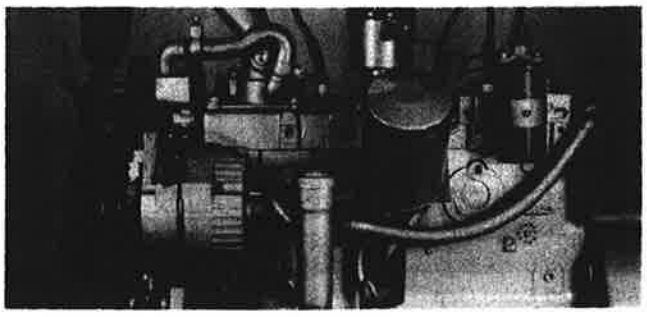
EVERY 250 HOURS

1. REPEAT DAILY AND 50-HOUR SCHEDULES

Follow previous instructions.

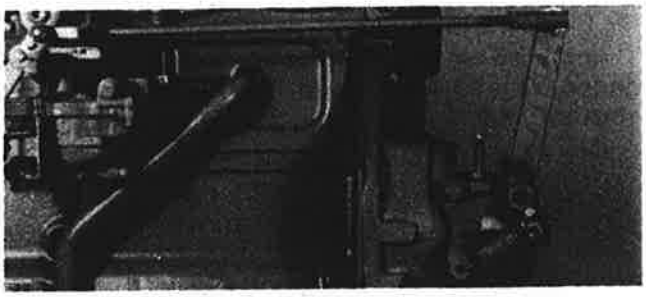
2. CLEAN EXTERIOR OF ENGINE

Use steam if available, otherwise any good commercial engine cleaner to wash down the engine.



3. CHECK GOVERNOR CONTROL

Clean and lubricate all governor linkage to insure free operation of governor. Free-up any joints that may be binding or rods or levers that may be twisted. Check for full throttle opening.



4. CLEAN SPARK PLUGS

Clean depressions around plugs before removing them — then clean and re-set point gap to .025 on standard plugs.

Install spark plugs (18mm) and tighten to 35 ft. lbs. torque.

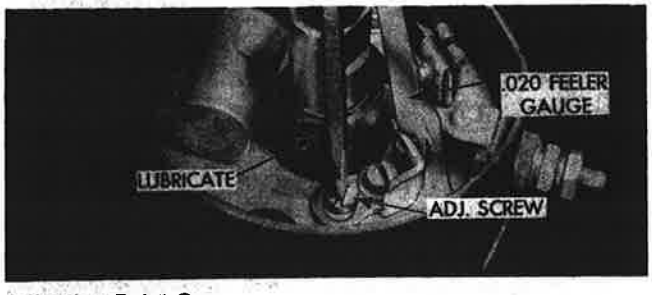
Re-set Spark Plug Gap

5. CHECK DISTRIBUTOR (Breaker Type Ignition)

Clean distributor cap inside and outside with solvent without removing wires and blow off with compressed air — Inspect cap and rotor for cracks.

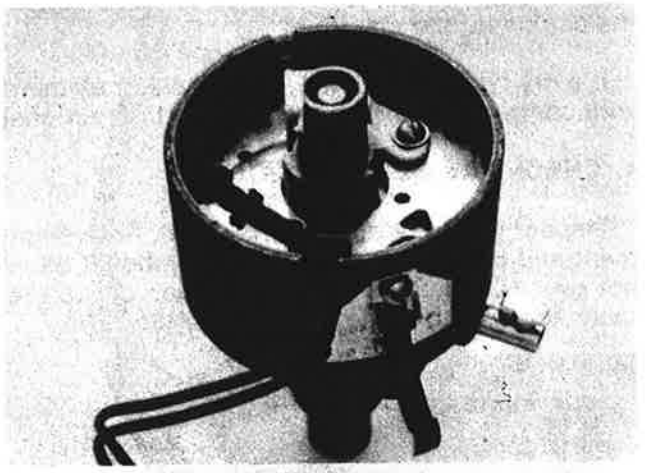
Examine contact surfaces of points — replace if burned or pitted and adjust to .020 gap.

Lubricate distributor cam sparingly.



Adjusting Point Gap

The Electronic Ignition Distributor requires no adjustments due to the elimination of the points and condenser. A sensor and trigger wheel device replace the points and condenser in the distributor and provide the precise timing needed to fire the plugs.



⚠ WARNING

Stop engine before checking battery terminals or electrical connections. Do not hold ignition wires with bare hands since shocks or other injuries can result. Sparks or flames near a battery could cause an explosion or fire. Battery acid can cause corrosive burns. Always wear eye protection. Use of jumper cables or battery charging should be done only as directed by manufacturers safety instructions.

Read and observe safety warnings on pages 1 and 2.

6. INSPECT IGNITION WIRES AND CONNECTIONS

Examine ignition wires for breaks in insulation, chafing and loose connections. Replace if defective.

7. IF DRY REPLACEABLE ELEMENT AIR CLEANER IS USED, REPLACE ELEMENT.

8. SERVICE PCV SYSTEM (Refer to page 49)

EVERY 500 HOURS

1. REPEAT DAILY — 50 HOUR AND 250 HOUR SCHEDULES

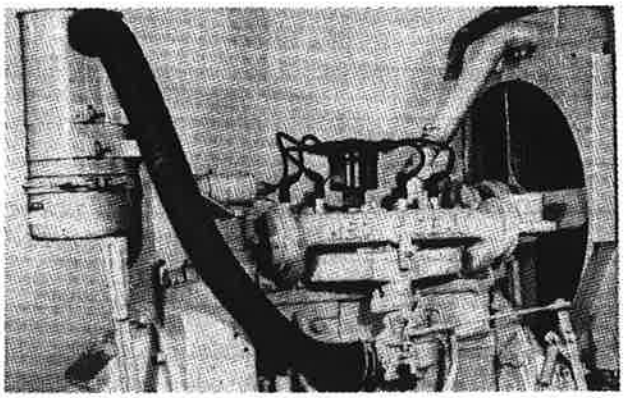
2. COOLING SYSTEM

Clean radiator core by blowing out with compressed air.

Inspect radiator mounting.

Inspect water pump and connections for leaks.

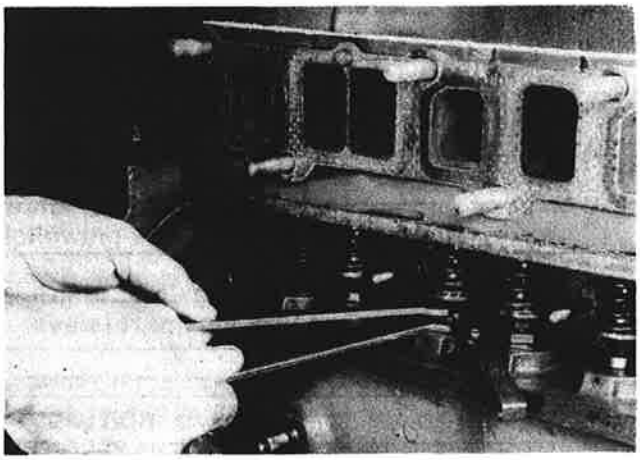
Check fan and accessory drive belts.



Inspect Cooling System Connections

3. ADJUST VALVE TAPPET CLEARANCE

Check and adjust intake and exhaust valve tappets to following clearances when engine is warm.



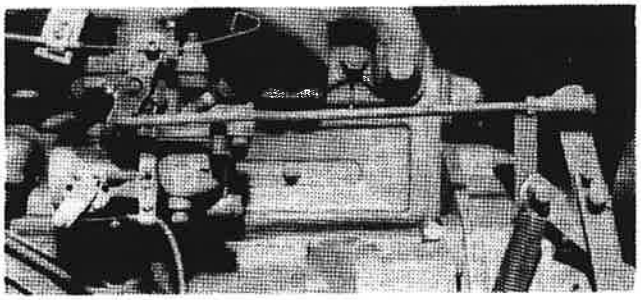
Adjusting Valve Tappet Clearance

MODEL	INTAKE	EXHAUST
TC 56, Y112, F163, F227, F245	.012	.020

4. CARBURETOR

Clean exterior and check mounting to manifold.

Adjust carburetor air adjustment for even running and adjust idle speed to 400-600 R.P.M. minimum for the Y and F series engines and 800 R.P.M. minimum for the TC56 engine.



Carburetor

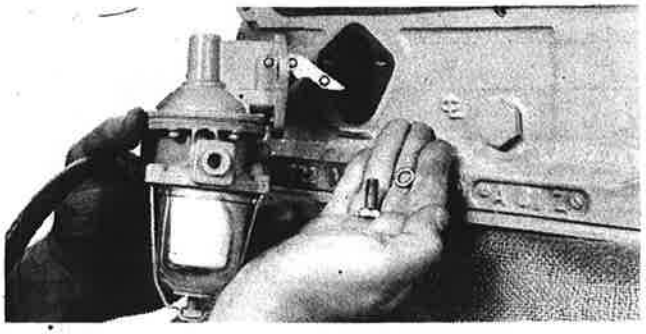
Inspect throttle and choke linkage for free operation.

5. FUEL PUMP

Clean Filter bowl and screen.

Inspect mounting and gasket.

Check all connections for leaks.



Fuel Pump Mounting

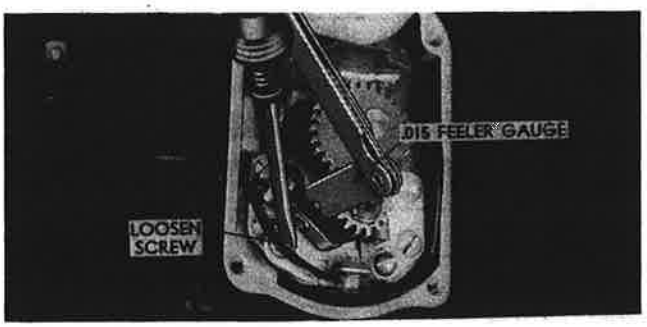
6. MAGNETO (when equipped)

⚠ WARNING

Magneto wires carry high voltage electrical current capable of giving a shock. If you grasp the molded wire, make sure it is well back of the open end using insulated pliers.

Read and observe safety warnings on pages 1 and 2.

Spark test with engine operating by checking firing with each high tension cable held about 1/16" away from spark plug terminal.



Adjust Magneto Point Gap

Remove end cap and examine carbon brushes for free-movement and inspect breaker points for wear and gap. Gap should be .015.

7. SAFETY AND THERMAL CONTROLS

Inspect control wires and connections.

Examine armored capillary tubing on water temperature element for visual damage that may cause faulty operation.

Section 10 - Trouble Shooting

⚠ WARNING

Bodily injury or death may result to individuals during operation of an engine within any enclosure not adequately or properly ventilated. Engine operation in any enclosure requires adequate and proper ventilation to avoid asphyxiation or other interruption of normal breathing, to supply sufficient air to cool the engine, provide air to mix with fuel and to carry away heated air from the building.

Read and observe safety warnings on pages 1 and 2.

A preventive maintenance system including inspection, lubrication and adjustment as recommended in our Maintenance Section will prevent the greater portion of gasoline engine troubles.

Failure of a gasoline engine to start is mainly due to two things: ignition trouble or failure in the fuel system.

Operators handling the same engine every day, soon develop a sense of impending trouble when abnormal operation occurs. Immediate attention to these danger signals can prevent major failures, insure dependable operation and increase the life of the engine.

Operators should depend on their well-developed senses of **feeling, hearing, seeing** and **smelling** and replace their sense of taste in this type of work — **with a generous amount of "Common Sense".**

A good rule to follow in locating trouble is to never make more than **one** adjustment at a time — then locate the trouble by a process of elimination. Remember the cause is usually **Simple** — rather than mysterious and complicated.

Following are listed some of the normal complaints encountered in routine operation of all gasoline engines and the probable causes.

A — STARTING MOTOR — WILL NOT CRANK ENGINE:

1 — Weak or dead battery.
2 — Poor ground connection.
3 — Faulty starting switch or relay.
4 — Defective starting motor.
5 — Internal engine seizure — turn engine manually to determine cause.

B — ENGINE CRANKS — BUT DOES NOT START:

Disconnect one spark plug wire, turn ignition on with starter cranking engine and free end of wire 1/8" from cylinder head — note spark.

⚠ WARNING

Do not hold ignition wires with bare hands since shocks or other injuries can result. Sparks or flames near a battery could cause an explosion or fire. Battery acid can cause corrosive burns. Always wear eye protection. Use of jumper cables or battery charging should be done only as directed by manufacturers safety instructions.

Read and observe safety warnings on pages 1 and 2.

1 — **NO SPARK:**

(A) — **If Ammeter Shows No Discharge** — it indicates an open primary circuit due to

1 — Points not closing.
2 — Open primary wires.
3 — Defective ignition switch.
4 — Faulty coil.

(B) - **Normal Ammeter Reading** (Discharge 2-5 amps) — this indicates that the primary circuit is OK — trouble may be in secondary circuit due to:

1 — Broken or grounded high tension wire from coil to distributor.
2 — Wet high tension wires.
3 — Faulty distributor cap or rotor.
4 — Broken secondary winding of coil.

(C) — **Excessive Ammeter Reading** (Discharge over 5 amps) — indicates a "short" in the primary winding which may be due to:

1 — Shorted or grounded primary winding.
2 — Distributor or magneto points not opening.
3 — Grounded breaker point arm.
4 — Defective condenser.

2 — **WEAK SPARK** — may be caused by:
(A) Loose ignition wiring connections.
(B) Burned or pitted distributor points.
(C) Wet spark plug wires.
(D) Defective condenser.
(E) Cracked distributor cap.
(F) Weak ignition coil.

3 — **GOOD SPARK AT EACH PLUG** — Indicates that ignition system is OK and trouble is in fuel system — which may be due to:

(A) **No Gas in Carburetor** — which may be due to:

1 — No gas in tank.
2 — Clogged filter or lines.

3 — Faulty fuel pump.
4 — Leaky fuel line from tank.
5 — Plugged vent in fuel tank cap.

(B) **Gas In Carburetor** — which may be flooded due to:

1 — Too much choking — plugs are wet.
2 — Wrong float level.
3 — Choke not operating correctly.
4 — Water in Gas.

C — ENGINE RUNS WITH CONTINUOUS MISFIRING: Due to:

1 — Uneven compression.
2 — Wet or deteriorated high tension wires.
3 — Cracked distributor cap.
4 — Faulty spark plugs—if spark plug porcelain is white when removed, use **Colder** plug — if light brown OK — if Black or oily use **Hotter** plug.

D — ENGINE RUNS UNEVENLY

1 — **At Idling Speed** — which may be due to:
(A) Too wide spark plug gaps.
(B) Poor Carburetor idle adjustment.
(C) Wrong float level.
(D) Carburetor or intake manifold air leaks.
(E) Leaky cylinder head gasket.

2 — **At High Speed** — which may be due to:
(A) Wide breaker points.
(B) Weak distributor breaker arm spring.
(C) Weak valve springs.
(D) Spark plug of wrong type or incorrect gap.

E — ENGINE RUNS IMPROPERLY

1 — **Back-Firing into Manifold** — indicates **Too Rich** a fuel mixture; into carburetor indicates **Too Lean** a mixture—may be due to:
(A) Late Ignition Timing.
(B) Clogged Air Cleaner.
(C) Fuel line restrictions.
(D) Clogged carburetor jets.
(E) Sticking Valves.
(F) Weak or broken valve springs.

2 — **Excessive Ping (Detonation)**—Results in damaged pistons and bearings and is caused by pre-ignition or using inferior grade of gas.
3 — **Engine Idles Too Fast** — indicates improper throttle adjustment or weak throttle return springs.
4 — **Engine Dies When Idling** — which indicates incorrect speed or mixture adjustment; clogged idling circuit in carburetor or wrong choke adjustment, or air leaks in intake manifold.
5 — **Engine "Stumbles" on Acceleration** — which may be due to defective accelerator pump or air in fuel lines.
6 — **Defective Spark Plugs.**

F — LACK OF POWER — which may be due to:

1 — Poor Compression.
2 — Wrong Timing.
3 — Throttle control not opening fully.
4 — Air leak in fuel system.
5 — Restriction in air cleaner — should have vacuum less than 10" water.
6 — Exhaust line obstructed — should have back pressure of not more than 20" water.
7 — Poor fuel.
8 — Piston rings sticking or worn.

G — POOR COMPRESSION — check with compression gauge — if irregular, seal the piston with a teaspoonful of engine oil poured through the spark plug hole, and take a second reading; if pressure does not increase this will indicate that poor seating of valves are at fault.
Poor compression may be due to:

1 — Valves holding open — no tappet clearance.
2 — Leaky cylinder head gasket.
3 — Broken or weak valve springs.
4 — Burned or sticking valves.
5 — Badly worn, broken or stuck piston rings.
6 — Wrong valve timing.

H — OVERHEATING

1 — Lack of water in radiator.
2 — Fan belts slipping.
3 — Thermostat sticking or inoperative.
4 — Radiator clogged or leaky.
5 — Late ignition timing.
6 — Back pressure in exhaust line.
7 — Defective water pump.
8 — Overloading of engine.

I — LOW OIL PRESSURE

⚠ WARNING

Before the oil pressure relief valve is removed, the engine must be stopped.
Read and observe safety warnings on pages 1 and 2.

1 — Low Oil level.
2 — Oil pressure gauge or line faulty.
3 — Oil too light — diluted.
4 — Suction screen plugged.
5 — Dirt in relief valve or broken spring.
6 — Worn bearings.
7 — Worn or damaged oil pump gears.
8 — Worn Cam Bushings.

J — HIGH OIL PRESSURE—should not exceed recommended pressures except when

engine is starting up cold. Abnormally high oil pressure is not desirable because it increases oil consumption — possible causes of high oil pressures are:

⚠ WARNING

Before the oil pressure relief valve is removed, the engine must be stopped.
Read and observe safety warnings on pages 1 and 2.

1 — Engine oil too heavy.
2 — Stuck relief valve.
3 — Obstruction in distributing line.
4 — Faulty oil pressure gauge.

K — HIGH OIL CONSUMPTION

1 — Oil leaks.
2 — Too high oil level.
3 — Incorrect grade of oil used.
4 — Clogged crankcase breather.
5 — Oil pressure too high — stuck relief valve.
6 — Piston rings not run-in, due to too smooth cylinder bore finish or glazed condition.
7 — Worn, broken or stuck piston rings and clogged oil control rings.
8 — Worn pistons and bores.
9 — Worn bearings.
10 — Worn valve guides.
(Manifold may be removed for visual inspection.)

L — ENGINE KNOCKS AND OTHER NOISES

1 — Operating Knocks — which may be due to:

(A) **Pre-Ignition** — Most comon cause is due to wrong type plugs which are too hot.

(B) **Carbon** — noticeable when engine is accelerated while hot — clean head and pistons.

(C) **Timing** — early timing causes knocks similar to carbon — but may tend to kick back when starting.

(D) **Fuel** — detonation knock caused by poor gas.

(E) **Overloads** — particularly at lower operating speeds.

2 — **Mechanical Knocks**—result from wear, abuse or improper adjustments — which may be due to:

(A) **Crankshaft and Main Bearings:**

(1) Worn or burned-out Main Bearings — A heavy, dull knock when accelerating under load. Locate by shorting out plugs on both sides of the bad bearing.

(2) **Crankshaft End-Play** — excessive end-play is indicated by an intermittent knock which will come and go when the load is released and engaged.

(B) **Connecting Rod Bearings**

(1) **Worn or Burned-out Bearings** — The worst condition, a light pound or metallic knock, is noted at idling and to about 2/3 maximum speed. Bad bearings can be determined by shorting out plugs.

(C) **Pistons and Wrist-Pins**

(1) **Loose Wrist Pins** — noise doubles when the correct plug is shorted out — most noticeable at idling speed.

(2) **Piston Loose in Cylinder** — "Piston-Slap" is noted by metallic knocking at low speed under load: but disappears at high speed — also most noticeable when starting cold—test by shorting out plugs.

(D) **Broken Piston Ring or Pin** — Sharp clicking noise that won't short out.

(E) **Valves**

(1) **Burned Valves and Seats** — engine misses, especially at low speeds, or acceleration under load.

(2) **Weak or Broken Valve Springs** — missing at low or high speeds when under load.

(3) **Sticking Valves** — loss of power and popping sound when bad.

(4) **Tappet noise** — excessive clearances cause noise when cold — which diminishes at normal operating temperature.

(F) **Camshaft** — Noise due to loose bearings or end play — usually occurs at half engine speed.

(G) **Timing Gear Noise** — Loose or worn gears rattle or knock — tight gears hum.

3 — **Vibration Originating at Engine** — The most common sources of vibration originating in or on the engine, as distinguished from causes created outside the engine are as follows:

(A) Misfiring.
(B) Misalignment of engine.
(C) Bent or off-center coupling.
(D) Engine loose on bed and type of mountings
(E) Out of balance condition of flywheel and clutch assembly.

SERVICE AND PARTS

AVAILABLE FROM YOUR AUTHORIZED TELEDYNE TOTAL POWER SERVICE CENTER

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3409 Democrat Road
P.O. Box 181160
Memphis, Tennessee 38181-1160
Phone: (901) 365-3600
TELEX: 462-1058 (ITT)

European Office
Rue Joseph Deflandre, 13
B-4920 Chaudfontaine (Liege)
Belgium
Phone: (32) (41) 67 53 20
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